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ANNUAL REPORTS

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE YEAR ENDED JUNE 30,

1909.

REPORT OF THE

SECRETARY OF AGRICULTURE.

REPORTS OF CHIEFS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1910.

[CHAPTER 23, Stat. at L., 1895.]

[AN ACT Providing for the public printing and binding and the distribution of public documents.]

* * * * * * *

Section 73, paragraph 2:

The Annual Report of the Secretary of Agriculture shall hereafter be submitted and printed in two parts, as follows: Part One, which shall contain purely business and executive matter which it is necessary for the Secretary to submit to the President and Congress; Part Two, which shall contain such reports from the different bureaus and divisions, and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be specially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information. There shall be printed of Part One, one thousand copies for the Senate, two thousand copies for the House, and three thousand copies for the Department of Agriculture; and of Part Two, one hundred and ten thousand copies for the use of the Senate, three hundred and sixty thousand copies for the use of the House of Representatives, and thirty thousand copies for the use of the Department of Agriculture, the illustrations for the same to be executed under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, said illustrations to be subject to the approval of the Secretary of Agriculture; and the title of each of the said parts shall be such as to show that such part is complete in itself.

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CONTENTS.

REPORT OF THE SECRETARY.

Page.

Agricultural production of 1909 9
Prices of meat 15
Rising prices of farm products 31
Work of the Department in 1909 34
    Enforcement of the Food and Drugs Act 34
    Other legal operations of the Department 42
    Need for Federal inspection of insects and nursery stock 44
    Changes in the personnel 45
    Weather Bureau 45
    Bureau of Animal Industry 50
    Bureau of Plant Industry 64
    Forest Service 90
    Bureau of Chemistry 99
    Bureau of Soils 102
    Bureau of Entomology 107
    Bureau of Biological Survey 115
    Division of Accounts and Disbursements 125
    Division of Publications 127
    Bureau of Statistics 129
    The Library 132
    Office of Experiment Stations 133
    Office of Public Roads 147
Salaries of scientists 150
Field diaries 151
Consolidation of work 151

REPORTS OF CHIEFS.

Report of the Chief of the Weather Bureau 155
    Research observatory at Mount Weather, Va 155
    Forecasts and warnings 158
    The Key West hurricane of October 11, 1909 165
    River and flood service 170
    Instruments 171
    Climatological division 173
    Marine division 176
    School of instruction 181
    Distributing division 181
    Telegraph division 184
    Observatory buildings 186
    Statistics of the service 191
Report of the Chief of the Bureau of Animal Industry 195
    Organization and administration 195
    Foot-and-mouth disease 196
    The meat inspection 199
    Eradication of cattle ticks 201
    Tuberculosis 202
    Lip-and-leg ulceration of sheep in the Northwest 204
    Proposed plan for reporting diseases 204
    Veterinary education 204
    Supervision of vaccines, serums, etc 205
    The dairy industry 206
    Need for inspection of dairy animals and products 207
    Publications 208
    The inspection division 208
    The quarantine division 215

Report of the Chief of the Bureau of Animal Industry—Continued. Page.
- The pathological division 220
- The biochemic division 233
- The zoological division 238
- The experiment station 240
- The animal husbandry office 244
- The dairy division 249

Report of the Chief of the Bureau of Plant Industry 261
- General work of the year 261
- Investigations, experiments, and demonstrations in pathology and bacteriology 265
  - Laboratory of plant pathology 265
  - Pathological collections and inspection work 266
  - Diseases of cotton and truck crops 267
  - Fruit-disease investigations 269
  - Investigations in forest pathology 271
  - Soil bacteriology and water purification 272
- Crop physiology and breeding investigations 274
  - Breeding and adaptation work with fruit and nut crops 274
  - Clover and alfalfa investigations 277
  - Cooperation with the Indian service 278
- Drug-plant, poisonous-plant, and general physiological investigations 279
  - Drug-plant investigations 279
  - Poisonous-plant investigations 283
- Investigations of technological and other special agricultural problems 285
  - Cotton standardization and paper-plant tests 285
  - Fiber investigations 286
  - Taxonomic and range investigations 287
  - Seed laboratory 291
  - Grain standardization 292
- Breeding and adaptation work with farm crops 294
  - Grain investigations 294
  - Corn investigations 299
  - Sugar-beet investigations 307
  - Tobacco investigations 309
- Investigations and experiments in the arid and semiarid regions 316
  - Dry-land agriculture investigations 316
  - Western agricultural extension 318
  - Alkali and drought resistant plant breeding 319
- Farm-management investigations 321
  - Southern farm-management districts 321
  - Northern farm-management districts 326
  - Western farm-management districts 329
  - Farm-practice investigations 330
  - Farm economics 333
  - Range-management and cactus investigations 335
- Farmers' cooperative demonstration work 337
- Arlington Experimental Farm and horticultural investigations 340
- Pomological investigations 345
  - Pomological collections 345
  - Field investigations in pomology 346
- Greenhouses, gardens, and grounds 354
- Work relating to the purchase and distribution of seeds 357
  - Foreign seed and plant introduction 357
  - Forage-crop investigations 363
  - Congressional seed distribution 368
- Work at special testing gardens 370

Report of the Forester 371
- Classification of expenditures 371
- The National Forests 372
  - Area 372
  - Claims and settlement 375
  - Enforcement of law 378
  - Cost and use 379
  - Executive force 380
  - Business organization 381
  - Objects and results of administration 382

Report of the Forester—Continued. Page.
Federal cooperation 397
State cooperation 398
General investigations 400
Work for the ensuing year 409
Report of the Chemist 415
Special investigations 415
Denatured alcohol investigations 415
Effect of environment on chemical composition 416
Animal-physiological chemistry 420
Enological-chemical research 420
Bacterio-chemical examinations 421
Important food investigations 422
Special research work of the division of foods 422
Food technology 424
Canning investigations 425
Research work on the deterioration of foods 425
Examination of dairy products 427
Sugar-producing plants and their products 428
Drug work 429
Miscellaneous chemical investigations 439
Studies conducted by the miscellaneous division 439
Investigations of the leather and paper laboratory 442
Examination of supplies furnished on contract 444
Microchemical investigations 445
Nitrogen determinations 447
Food and drug inspection 447
The new building 464
Work outlined for the fiscal years 1910 and 1911 465
Report of the Chief of the Bureau of Soils 473
Progress of the soil survey 473
The year's work 473
General status of soil-survey work at the end of the fiscal year 1909 476
Recommendations for future work 479
Soil-water investigations 483
Soil-fertility investigations 485
Laboratory investigations 488
Report of the Entomologist 491
Work of the year 491
Work on the gipsy moth and the brown-tail moth 492
Importations of useful insects 495
Exportations of useful insects 499
Work on insects affecting southern field crops 500
Investigations of insects damaging forests 504
Investigations of insects damaging deciduous fruit trees 509
Cereal and forage-plant insect investigations 513
Work on insects injurious to vegetable crops 515
Work on insects affecting citrus fruits 516
Investigations of insects in their direct relation to health 519
Work on insects injurious to stored products 521
Inspection work 522
Work in bee culture 525
Proposed work for the fiscal year 1910 529
Plans of work recommended for year ending June 30, 1911 531
Report of the Chief of the Bureau of Biological Survey 533
Work of the Biological Survey 533
Economic mammalogy and ornithology 533
Geographic distribution 541
Game protection 542
Outline of work for 1910 549
Report of Chief of Division of Accounts and Disbursements 553
Organization 553
Work of the year 554
Appropriations, disbursements, and unexpended balances for 1909 555
Public moneys received from various sources 557
Buildings rented in the District of Columbia 559
Estimates of appropriations 560
Fiscal affairs of the Forest Service 564
Finances of the Department for seventy years 567

Page.

Report of the Editor ... 591
  Work of the year ... 591
    Summary of results ... 591
    Weather Bureau publications ... 595
    Farmers' Bulletins ... 595
    Sale of publications of the Department ... 598
    Administrative work ... 600
    Editorial work ... 603
    Handling and distribution of publications ... 605
    Illustrations ... 609
    Indexing ... 611
  Work of the Division for 1910 ... 612
  Recommendations ... 613
  Publications issued during the year ... 613
Report of the Chief of the Bureau of Statistics ... 655
  Organization ... 655
  Sources of information ... 659
  Crop Reporting Board ... 661
  Issuance of crop reports ... 662
  Cost of producing farm products ... 665
  Quinquennial agricultural censuses ... 666
  Work of the Bureau during the fiscal years ending June 30, 1910 and 1911 ... 667
  Recommendations ... 667
Report of the Librarian ... 669
  Work of the year ... 669
  Recommendations ... 682
Report of the Director of the Office of Experiment Stations ... 683
  Relations with agricultural experiment stations ... 683
  Relations with institutions for agricultural education ... 686
  Exhibit at the Alaska-Yukon-Pacific Exposition ... 693
  Work for the Civil Service Commission ... 693
  Insular stations ... 693
  Irrigation investigations ... 701
  Drainage investigations ... 705
  Nutrition investigations ... 708
Report of the Director of the Office of Public Roads ... 711
  Work of the year ... 711
    Object-lesson roads ... 715
    Instruction in highway engineering ... 731
    Lectures, addresses, and papers ... 732
    Special inspection and advice ... 732
    Investigations of road materials in the several States ... 734
    Model systems of road construction, maintenance, and administration ... 734
    Investigation of dust preventives and road preservatives ... 735
    Investigation of slag as a road material ... 736
    Corrosion of iron and steel ... 737
  Outline of plans for the current year ... 738
  Plans and recommendations for 1911 ... 738
Report of the Solicitor ... 739
  Duties of the Solicitor ... 739
  Legal advice ... 740
  Communications to the Department of Justice ... 741
    Food and Drugs Act ... 741
    The twenty-eight hour law ... 759
    The Lacey Act ... 773
    Suppression of contagious diseases of domestic animals ... 776
    Quarantine law and regulations ... 777
    Meat inspection ... 782
  Orders and regulations ... 783
  Legal papers ... 784
  Assistance in legal proceedings ... 786
  Patents for Department employees ... 787
Report of the Appointment Clerk ... 791
  Changes in the force of the Department ... 791
  Establishment and growth of the Department of Agriculture ... 793
  Pay-roll classification of officers and employees ... 803
  Principal officers of the Department ... 804
  Number of officers and employees on March 4, 1909 ... 810
  Civil service regulations governing promotions, etc., in the Department ... 811

REPORT OF THE SECRETARY OF AGRICULTURE.

REPORT

OF THE

SECRETARY OF AGRICULTURE.

Mr. President:

I respectfully present my Thirteenth Annual Report, covering the work of the Department of Agriculture for the year 1909.

A review of the agricultural production of 1909 is first given. Next, the results of a careful study of the prices of meat are offered, and this discussion is followed by a consideration of the extent to which the farmer has shared in the benefits of generally rising prices. The remainder of the report is taken up with an account, in greater or less detail, of the Department's work during the year.

AGRICULTURAL PRODUCTION OF 1909.

VALUE MUCH HIGHER THAN FOR ANY PREVIOUS YEAR.

MOST PROSPEROUS OF ALL YEARS.

Most prosperous of all years is the place to which 1909 is entitled in agriculture. The yield has been bountiful with most crops, and prices have been high. Advantageously situated as he is in most respects, the farmer is less and less generally compelled to dump his crops on the market at time of harvest. He does not need to work for his board and clothes, as he often did in the former time when prices were so low as to be unprofitable.

VALUE OF ALL PRODUCTS.

The value of the farm products is so incomprehensibly large that it has become merely a row of figures. For this year it is $8,760,000,000; the gain of this year over the preceding one is $869,000,000.

Ten years ago the value of the products of the farm was only five and one-half times the mere gain of this year over 1908; it was little more than one-half of the total value of this year. The value of the products has nearly doubled in ten years.

If the total value of the farm products in 1899, as established by the census, is placed at 100, the value for 1903 is represented by 125, for 1904 by 130, for 1905 by 133, for 1906 by 143, for 1907 by 159, for 1908 by 167, and for 1909 by 186.

Eleven years of agriculture, beginning with a production of $4,417,000,000 and ending with $8,760,000,000! A sum of $70,000,000,000 for the period!

It has paid off mortgages, it has established banks, it has made better homes, it has helped to make the farmer a citizen of the world, it has provided him with means for improving his soil and making it more productive.

CHIEF CROPS.

In the statement that follows concerning the crop quantities and values for 1909 no figures should be accepted as anticipating the final estimates of this Department to be made later. Only approximations can be adopted, such as could be made by any competent person outside of this Department.

CORN.

The most striking fact in the world's agriculture is the value of the corn crop of 1909 in this country. It is about $1,720,000,000.

It nearly equals the value of the clothing and personal adornments of 76,000,000 people, according to the census of 1900. The gold and silver coin and bullion of the United States are not of greater value.

This corn came up from the soil and out of the air in one hundred and twenty days—$14,000,000 a day for one crop, nearly enough for two dreadnoughts daily, for peace or war.

The value of this corn crop is the highest of record and it is greater than the average of the five preceding years by 36 per cent, while the farm price per bushel is greater by 32 per cent. The price per bushel on November 1, 62.2 cents, has been exceeded in only two years in the records of the Department of Agriculture, beginning with 1866.

In quantity of production this year's corn crop stands second, with 2,767,000,000 bushels, being exceeded by the crop of 1906, but it is greater than the average crop of the five preceding years by 3.5 per cent.

COTTON.

Cotton is now by far the second crop in value, and this year's crop is easily the most valuable one to the farmer that has been produced. With cotton lint selling at 13.7 cents at the farm November 1, and cotton seed selling for about $25 per ton, the lint and seed of this crop are worth about $850,000,000 to the farmer. No other cotton crop since 1873 has been sold by farmers for as high a price per pound as this one.

There have been three cotton crops of more than 13,500,000 bales of 500 pounds gross weight, the first one being in 1904, and commercial expectations are that the crop of this year will be below the average of the five years preceding.

WHEAT.

Third in order of value among the crops is wheat, worth about $725,000,000 at the farm, and this exceeds all previous values by a large amount. The November farm price was almost an even $1 per bushel, and its equal can not be found until as long ago as 1881. The total value of this year's crop is greater than the five-year average by 34.6 per cent.

In 1901 and in 1906 slightly larger crops of wheat were produced, so that the yield of this year, 725,000,000 bushels, is third in size.

HAY.

For years hay and wheat disputed with each other the honor of the place next after cotton in value, but this year the separation is distinct, and hay, with its value of about $665,000,000, is considerably below wheat and far below cotton. Only in one year, 1907, has its value been overtopped, and it is 10 per cent above the five-year average. The quantity of the hay crop, 64,000,000 tons, has several times been greater than it is this year, although it is now 2.6 per cent above the average of five years preceding.

OATS.

The fifth crop in order of value is oats, worth this year at the farm about $400,000,000, which is considerably above high-water mark, and is greater than the five-year average by 28 per cent. The price of November 1, 41 cents, is high, and only in 1907 and 1908 has it been higher since 1890. In production this crop is very nearly a leader, with its 984,000,000 bushels, and would have been a leader had not the crop of 1902 been about 4,000,000 bushels larger. It is greater than the five-year average by over 12 per cent.

POTATOES.

This year's crop of potatoes is more valuable than any one before produced and is worth about $212,000,000. It is above the five-year average by 25 per cent. The November price, 57.8 cents per bushel, has often been exceeded.

The large production is what makes the crop so valuable, a production that has not been equaled; it is 367,000,000 bushels, or 24 per cent above the five-year average.

TOBACCO.

Tobacco is now marketed under circumstances that secure a higher price per pound than farmers have received since 1865, except in two or three years. Since 1905 the farm price has been 10 cents or better. The farm value of this year's crop is a little under $100,000,000 and has not been equaled. It is nearly 50 per cent above the five-year average. This great value is principally due to the fact that the crop is the largest ever raised, with about 900,000,000 pounds, or one-third greater than the average of five years.

SUGAR.

It is too early to foresee the amount of the beet sugar of this year's campaign, but the indications are about 500,000 short tons, or a greater crop than any before produced. The value of the sugar and of the beet pulp for feeding purposes is about $47,000,000, an amount that has not been reached in any earlier year.

If the commercial estimate of 364,000 short tons for raw cane sugar is accepted, it is a little below the record of half a dozen years. The value of the cane sugar, molasses, and sirup is placed at $40,000,000.

With fulfillment of expectations, the entire sugar crop will be about 864,000 tons (refined beet sugar and raw cane sugar), and the value of all sugar, molasses, and sirup, from farm and factory, will reach about $95,000,000, so that for quantity of total sugar and value of total sugar, molasses, and sirup, this year is a leading one.

BARLEY.

Barley has receded from its very high price of 1907, but still has a price, 53.3 cents per bushel November 1, which has not been equaled since 1890, except in 1907 and 1908. The farm value of this year's crop is nearly $88,000,000, which has been exceeded only twice, and is 15 per cent over the average of the previous five years.

The production, 165,000,000 bushels, is third in quantity, although, compared with five years before, it is 6 per cent higher.

FLAXSEED.

The production of flaxseed seems to be declining, and the crop of this year is estimated at 25,767,000 bushels, a trifle under the five-year average. But the value of the seed per bushel, $1.398, is the highest since the Bureau of Statistics began to ascertain the farm price in 1902, and the crop is worth $36,000,000, or considerably more than ever before, and 40 per cent over the average of the previous five years.

RICE.

The estimate of rough rice production this year is a little over 1,000,000,000 pounds, an amount considerably above the highest previous crop. It is 21 per cent over the five-year average. The lead of the value is even more pronounced, since the price is high, and the total for the crop is about $25,000,000.

RYE.

Rye is a crop that remains at almost constant production, about 31,000,000 bushels, and the value this year is about $23,000,000, which has often been exceeded.

HOPS.

A shortage in the world's crop of hops this year raised the price to a high figure, about 33 cents for New York and about 24 cents for the Pacific Northwest. It happened, however, that a large proportion of the Pacific coast crop had been contracted for last year at about 9 cents, so that the average price paid for the whole crop is not as high as market prices indicate. The quantity of the hop crop this year is below the five-year average, but the value is about $8,000,000, or next to the highest year.

ALL CEREALS.

Although a bushel of oats weighs less than a bushel of other cereals, yet there is considerable significance in comparing the total quantity of all cereals in recent years. The total for 1909 is 4,711,000,000 bushels, an amount considerably greater than that for any other year except 1906, when the total was 4,872,000,000 bushels. The average of five years is exceeded in 1909 by 6.5 per cent.

The farm value of all cereals in 1909 has never been equaled in a previous year. It is almost exactly $3,000,000,000, or 34 per cent above the five-year average.

SUMMARY OF COMPARISONS.

Compared with the average of the preceding five years, every one of the crops particularized in the foregoing was larger, except cotton, flaxseed, hops, and cane sugar. Without exception every crop was worth more to the farmer than the five-year average.

This is the year of highest production for potatoes, tobacco, beet sugar, all sugar, and rice; a year of next to the highest production for corn, oats, and all cereals; the crop third in size for wheat.

For value, the amount has not been equaled in the case of corn, cotton, wheat, oats, all cereals, potatoes, beet sugar, all sugar, flaxseed, and rice; the year is next to the highest for hay, cane sugar, and hops; and the barley crop is third in value.

Compared with 1908, this year's gains in value of farm products are found all along the line, the exceptions being barley, buckwheat, rye, and milk. The increase for cotton—lint and seed—is $208,000,000; wheat, $107,000,000; corn, $105,000,000; hay, $29,000,000; oats, $22,000,000; tobacco, $18,000,000; potatoes, $15,000,000.

There were substantial gains in value of dairy and poultry products and of animals sold and slaughtered. The price of butter has not been so high in many years, and the same is true for eggs and dressed poultry, and, except for the higher price of last year, is also true for milk.

In the grand total, the farm products of 1909 are greater in value than those of 1908 by $869,000,000, or by enough to buy a new equipment of farm machinery for over 6,000,000 farms.

All cereal crops of 1909 are worth $3,000,000,000 to the farmer, an amount that would pay for all of the machinery, tools, and implements of the entire manufacturing industry in this country.

All crops are worth $5,700,000,000, which would make a half payment on the value of all steam railroads, according to the valuation of 1904. All animal products are worth over $3,000,000,000.

The total of all items is $8,760,000,000. In eleven years of application of mind, muscle, and machine to this basic industry of mankind, the wealth produced by farmers, estimated as previously described, is valued at $70,000,000,000.

FOREIGN TRADE IN AGRICULTURAL PRODUCTS.

The value of the agricultural exports of domestic products for the year ending June 30, 1909, has been exceeded in four years—in 1901, 1906, 1907, and 1908. The value for 1909 is $903,000,000, or $151,000,000 below the highest record in 1907, and $114,000,000 below the next highest in 1908.

Compared with 1908, the prominent decreases were $11,500,000 for live animals, $26,000,000 for packing-house products, $20,000,000 for cotton, $55,000,000 for grain and grain products, and $3,800,000 for tobacco. On the other hand, there was an increase of over $7,000,000 in exports of oil cake, oil-cake meal, and vegetable oils.

The domestic exports of beef and beef products declined from 579,000,000 pounds in 1908 to 419,000,000 pounds in 1909; of pork and pork products, from 1,237,000,000 to 1,053,000,000 pounds; of wheat, from 100,000,000 to 67,000,000 bushels; of wheat flour, from 14,000,000 to 10,500,000 barrels; of wheat and wheat flour in terms of wheat, from 163,000,000 bushels in 1908 to 114,000,000 bushels in 1909.

The imports of agricultural products were never so high in value as they were in 1909, the amount being $637,000,000. Principal gains were $15,000,000 in silk, $21,500,000 in wool, $25,600,000 in packing-house products, mostly hides, $11,400,000 in coffee, and $16,500,000 in sugar.

After allowing for the $10,000,000 in exports of foreign origin, the net balance of foreign trade in agricultural products in favor of this country is $256,000,000, the lowest amount since 1896. This was more because of increased imports than of decreased domestic exports. The balance of trade in favor of this country in products other than agricultural for 1909 is $46,000,000.

In foreign trade in forest products the exports of domestic origin were valued at $72,000,000, an amount that has been exceeded in only three years; compared with 1908, there was a loss in all prominent items. The imports of forest products had a value of $124,000,000 and were never before so large in value. India rubber gained $25,000,000, compared with 1908. With respect to the balance of trade in forest products, it was against this country by about $47,000,000.

The agricultural production of 1909 must add much to the prosperity of farmers. The record is unexampled in wealth produced and tells of abundance in quantity. Year by year the farmer is better and better prepared to provide the capital and make the expenditures needed to improve his agriculture and to educate his children for farm life and work.

PRICES OF MEAT.

INCREASE OF RETAIL PRICE OVER WHOLESALE.

SPECIAL INVESTIGATION.

High prices of fresh meats and of their products are of such concern to nearly every family that an examination of the subject is timely. With over two-fifths of the expenditures of the families of medium income devoted to food and with one-third of the national dietary composed of meat, the present situation is felt by the incomes of 19,000,000 families.

The higher prices of meat in recent years do not bear the less heavily on the consumer because its purveyors at various points along the line of distribution may not have raised the price in a larger degree than the price of the animal has increased. There may be too large a net profit or gross profit, or the distributive processes may be too costly at some point. Little definite information has heretofore been extracted from the retail meat business concerning its cheapness or costliness in comparison with the amount of business done, and an acquaintance with the facts has become desirable.

Through employees of the Bureau of Animal Industry inquiries were made in 50 cities—large, medium, and small—in all parts of the country. A schedule was provided to record the actual experience of retailers in buying and selling the carcass or half carcass of beef. Among the facts ascertained were the weight and wholesale cost of a certain piece of beef, usually a half carcass. Then followed the weight and retail price of every cut for which a uniform price was charged by the dealer. Thus it became possible not only to compare high and low priced cuts, from the point of view of expense to consumer, but also to compute accurately the total retail price per pound and the total retail cost of the beef piece for which the wholesale price per pound and the total wholesale cost had been reported.

FACTS DISCOVERED IN FIFTY CITIES.

In the North Atlantic States the retail price of beef is 31.4 per cent higher than the wholesale price; and the percentage is usually lower in the larger cities than in the smaller ones, and higher in the case of beef that is cheap at wholesale than of high-priced beef.

In Allentown, Pa., there is an immediate gross profit of 50 per cent—that is, the total amount charged at retail is 50 per cent above the wholesale cost. Such gross profits are noticed for the smaller places as 46 per cent for Canajoharie, N. Y.; 50 per cent for Cortland, N. Y.; 47 per cent for Holyoke, Mass., and for Harrisburg, Pa. But for Olean, N. Y., the percentage is only 23 and for Springfield, Mass., 19, the low price being in strong contrast with the 47 per cent for Holyoke, its near neighbor, with a different sort of inhabitants.

A gross profit of 20 per cent was found in New York, N. Y., and Philadelphia, Pa.; 28 per cent in Buffalo, N. Y., and 36 per cent in Boston, Mass.

Everywhere appears the general fact that the lower the grade of beef the greater the percentage of gross profit. Allentown's high percentage is based on wholesale prices of 7½ and 8½ cents. In Boston the rate of gross profit is twice as great for 8-cent beef as for beef costing 11 and 11½ cents. Indeed, the rule is quite general that low-priced beef is marked up twice as much relatively as high-priced beef is. In other words, perhaps it is a safe inference that the poorer people pay nearly twice the gross profit that the more well-to-do people pay.

Baltimore, Md., in the South Atlantic States, is another large city with a low rate of gross profit, 17 per cent; but Washington, D. C., has a much higher rate, 42 per cent, and Takoma Park, D. C., 44 per cent. Richmond, Va., has the low rate of 21 per cent, and Augusta, Ga., the high one of 61 per cent. The amount for the South Atlantic States is 38 per cent.

In the North Central States the mean is 38 per cent, and the foregoing observations apply concerning the higher rate of gross profit for cheap beef. The Chicago, Ill., returns are for cheap beef, and the gross retail profit is 46 per cent, but in Cincinnati, Ohio, it is only 25 per cent; Omaha, Nebr., 23 per cent; South Omaha, Nebr., 25 per cent. Kansas City, Kans., has a cheap-beef gross profit of 50 per cent, while Kansas City, Mo., reports only 28 per cent.

For the twin cities, Minneapolis and St. Paul, Minn., the gross profit is reported at 27 and 35 per cent, respectively; for Detroit, Mich., and Milwaukee, Wis., 40 per cent; and for St. Louis, Mo., 39 per cent. In the smaller places the rates of gross profit in selling beef are 52 per cent for Alton, Ill.; 53 per cent for Cedar Rapids, Iowa; 43 per cent for East Liverpool, Ohio; 31 per cent for Port Huron, Mich.; 49 per cent for Wichita, Kans.; and 27 per cent for Winona, Minn.

No other division of States stands as high in gross profit as the South Central States, with 54 per cent. The places with rates above this mean are Fort Smith, Ark., 57 per cent; Mobile, Ala., 64 per cent; Nashville, Tenn., 63 per cent; Natchez, Miss., 56 per cent; and Shreveport, La., 68 per cent. On the other hand, Fort Worth, Tex., reports only 38 per cent; Louisville, Ky., 52 per cent; and Memphis, Tenn., 32 per cent.

The mean of 39.4 per cent of gross profit is derived from reports from the Western States. The highest rate is 62 per cent for Lewiston, Idaho; next, is 58 per cent for Spokane, Wash.; 50 per cent for Ogden, Utah; 39 per cent for San Francisco, Cal., and Cheyenne, Wyo.; 37 per cent for Denver, Colo.; 24 per cent in Seattle, Wash.; and 16 per cent for Tacoma, Wash.

For the 50 cities throughout the United States for which reports were received, the mean gross profit in selling beef, that is, the total retail cost charged to consumers above the wholesale cost paid by the retailers, is 38 per cent. In 5 cities the rate of increase is 20 per cent or under; in 10 cities, 21 to 30 per cent; in 12 cities, 31 to 40 per cent; in 12 cities, 41 to 50 per cent; and in 11 cities over 50 per cent.

RETAIL COSTS.

There are some services connected with a retail meat or meat and grocery business in a city that customers desire for their accommodation which are costly to them. They want delivery of goods, perhaps by special trip, and this requires at least one man, horse, and wagon. They want the market man also to send a man to their dwellings to take orders.

Much more productive of costliness to the retail distribution of meat is the overdoing of the retail business. The multiplication of small shops is a burden to consumers and no source of riches to the small shopkeepers. When twenty or more small shops divide the retail business within the area that could be served by one large shop, the expenses of the many shops for labor, horses, rent, and other things that are in excess of what would be sufficient for the one shop must go into the retail prices of the meat sold.

Furthermore, customers are disposed to focus their choice of cuts on certain ones, and these naturally bear the higher prices. If the porterhouse steak is really beyond the cash or credit of the customer, then a sirloin must be had, and a rib roast instead of another cut for roasting. Steaks and roasts are the preferences of beef customers, and the steaks and roasts must have names that are regarded as respectable. Consequently one-fifth of the carcass is bought at the highest prices—porterhouse steak at 25 to 30 cents a pound, sirloin at 20 to 25 cents, and rib roasts at 20 cents—these being some of the prices noted in the returns received from the 50 cities.

CONDITIONS AFFECTING MEAT SUPPLY.

PER CAPITA CONSUMPTION.

Among the peoples of the earth, except those of Australasia, the inhabitants of the United States are the most liberal meat eaters. Investigations made by this Department have disclosed the fact that the per capita consumption of meat in this country, in terms of " dressed " meat, was 185.8 pounds in 1900. If the edible parts outside of that description are included, such as heart, liver, tongue, and so on, the consumption was 220.5 pounds. If all this is reduced to strictly edible meat by exclusion of bones and other nonedible parts, the per capita meat consumption of men, women, children, and babies—that is, the average for all inhabitants—was 182.6 pounds in 1900.

The meat consumption of other countries is usually stated in terms of " dressed " meat, but may include some extraneous parts. As compared with 185.8 pounds of dressed weight of meat, standing as the per capita consumption of the United States, Cuba follows next in order with 124 pounds; the United Kingdom, 121.3 pounds; Germany, 115.94 pounds; France, 78.9 pounds; Denmark, 76 pounds; Belgium, 70 pounds; Sweden, 62 pounds. The average for Australia is apparently 262.6 pounds, and for New Zealand, 212.5 pounds.

The average meat consumption of the United States has long been declining. Primarily, the supply of meat in relation to population has declined since the first live-stock census in 1840. For cattle in that year, excluding calves, there was an average of 0.88 of an animal on farms to each inhabitant, 0.81 of an animal in 1860, 0.79 of an animal in 1880, 0.92 of an animal in 1890, and 0.69 of an animal in 1900. To a considerable extent, at least, range cattle are included. Since 1900, cattle have probably hardly increased absolutely, while population has gained nearly 20 per cent.

The comparison of sheep, excluding lambs, with population, shows that there were 1.13 animals on farms in 1840 to each inhabitant, 0.71 of an animal in 1860, 0.84 of an animal in 1880, 0.65 of an animal in 1890, and 0.52 of an animal in 1900. Range sheep are supposed to be included.

The decline for swine is about as great as that for sheep, and has been uninterrupted. The ratio of swine on farms to population in 1840 was 1.54 animals; in 1860 it was 1.07 animals; in 1880 it was 0.99 of an animal; in 1890 it was 0.92 of an animal; and in 1900 it was 0.83 of an animal.

MEAT EXPORTS.

In the meantime all of the meat produced in this country has not been eaten here. Prodigious exports have gone to all the countries of the globe. The exports of cattle for slaughter rose to 593,000 in 1904, since which time there has been a decline to 208,000 in 1909.

Most of the exports of meat and its products are stated in pounds in the foreign trade reports, and, as far as so stated, the exports of beef and beef products averaged 32,000,000 pounds yearly for 1851–1855, 109,000,000 pounds for 1871–1875, 234,000,000 pounds for 1881–1885, 340,000,000 pounds for 1886–1890, 521,000,000 pounds for 1891–1895, 601,000,000 pounds for 1896–1900, 617,000,000 pounds for 1901–1905, 733,000,000 pounds for 1906, 690,000,000 pounds for 1907, 579,000,000 pounds for 1908, and 419,000,000 pounds for 1909.

The high-water mark of beef exports was in 1906, since which year the decline has been so sharp that the exports of 1909 were only 57 per cent of those of 1906. Notwithstanding industrial depression abroad, evidently this indicated a decline in the supply of beef animals during the last three years relative to consumption in this country, especially since there has been no increased severity in the restrictions of European countries against the importation of beef. The significance of the foregoing is strengthened by the declining exports of beef cattle since 1904.

Pork and its products have far exceeded beef in exports. As far as stated in pounds—and little is omitted—the exports of pork and pork products averaged 91,000,000 pounds yearly in 1851–1855; 496,000,000 pounds in 1871–1875; 826,000,000 pounds in 1881–1885; 1,061,000,000 pounds in 1891–1895; 1,462,000,000 pounds in 1896–1900; 1,242,000,000 pounds in 1901–1905; 1,465,000,000 pounds in 1906; 1,268,000,000 pounds in 1907; 1,237,000,000 pounds in 1908; and for 1909 was 1,053,000,000 pounds.

In less degree than beef, pork exports indicate relatively, if not absolutely, a decline in the national supply in the last three years. While the ratio of meat animals to population has been declining during the last seventy years, exports of meat have grown to the unexampled total of 2,198,000,000 pounds of beef and pork and their products in 1906, and 593,000 beef cattle in 1904. The cattle exports fell to 208,000 animals in 1909 and the combined beef and pork exports fell to 1,472,000,000 pounds, or about 67 per cent of the high-water mark of three years before.

CHANGE IN DIETARY.

For two reasons the consumption of meat has declined in this country. The stock of meat animals has not been maintained in relation to population, and exports have increased to enormous proportions in a movement which culminated in 1906, to be followed by a sharp decline.

Seventy years ago the per capita consumption of meat was about one-half of the national dietary; in 1900 it had declined to about one-third or a little more; it may now be less than one-third.

If the entire stock of cattle, sheep, and swine are computed into meat pounds for the census years and the exports for those years are deducted, the remaining pounds may be regarded as the stock for national meat supply. Let per capita ratios be computed and let the ratio for 1840 be regarded as 100; then, by 1860, the per capita stock of meat animals declined to 82.5, by 1880 to 72.4, by 1890 to 79.4, and by 1900 to 59.3. In seventy years the per capita stock of animals for the national consumption of meat has declined to less than three-fifths of its former proportions.

It may not be that the people have unwillingly adopted a diminishing meat consumption. The diversification of agriculture and the abundant products of the farm must have had their effects on food habits. Vegetables that are locally out of season are brought from places as far away as 3,000 miles; and so with fruits, and in less degree with berries. The luxuries of former boyhood have become common foods of the present. The canning factory places the vegetable garden, the fruit orchard, and the berry field at the door of every household in the land during every day in the year. There are refrigerator cars for long-distance transportation and warehouses for cold storage. Eggs, dressed poultry, and butter are carried forward from a period of natural oversupply to a period of natural scarcity.

There is general agreement that wheat consumption for food has increased from about 4⅔ bushels to 5½ bushels per capita during the last twenty-five years. Sugar, a concentrated energy-supplying food, increased in consumption per capita from 14.1 pounds in 1840 to 30.5 pounds in 1860, to 42.9 pounds in 1880, to 52.8 pounds in 1890, to 65.2 pounds in 1900, and to 75.4 pounds in 1908.

The yearly consumption of sugar per family has increased since 1875 by 140 pounds. This has probably not fully displaced a nutritive equivalent in meat, but had it done so the displacement of meat in the annual family dietary would have been equal to 264.4 pounds of sirloin beef, or 349.5 pounds of round beef, or 155.9 pounds of cured ham, or 61.7 pounds of lard.

For every 100 pounds of rolled oats added to the national dietary within less than a generation, if there was an equivalent displacement of meat, for protein there would be required 101.7 pounds of sirloin beef, or 87.7 pounds of round beef, or 183.1 pounds of cured bacon; and for energy the equivalent is 187.8 pounds of sirloin beef, or 248.3 pounds of round beef, or 68.9 pounds of cured bacon.

The needed dietary of a certain number of calories can not be extended considerably and continually with impunity to health; so that if more fruits, vegetables, cereals, and sugar are eaten, some meat must be displaced. Meat, however, still remains the most prominent and costly group of foods.

REDUCTION OF RANGES.

As previously stated, the exports for recent years indicate that something has happened to the production or supply of beef. For 1906 and a few years before, the exports had been much above former figures. That was a period of dumping upon the market great numbers of beef cattle on the breaking up of the big western and northwestern range herds consequent upon enforcement of the "no-fence" law by the National Government.

Half a dozen years of this abnormal movement of beef cattle to the great markets began to tell upon the supply in 1908, when the deliveries fell off in a marked degree and the decrease continued in 1909.

Accompanying this drain upon the beef cattle of the country has been the encroachment of the settler upon the range. Former ranges, broad enough for an empire, have been broken by the farmer's plow. The secret of "dry farming" has been discovered, and one item of its achievements is a large proportion of a durum wheat crop of 50,000,000 bushels.

EXTRA DEMAND FOR CORN FOR FEEDING.

While ranges have been exhausted of their cattle, not all of the animals have gone directly to the slaughterhouses. A great proportion of them have found their way to farms for maturing and finishing, largely upon corn. The extra demand upon the corn crop is recorded in corn prices. From 1895 to 1900 the mean farm price of corn was 28 cents. The price of 60.5 cents in 1901 was due to a two-thirds crop because of drought. The price was quite uniform on a higher level from 1902 to 1906, and the mean was 41.6 cents per bushel. The following year it rose to 51.6 cents; in 1908, to 60.6

cents; and in November, 1909, to 62.2 cents. Higher prices coincide with the breaking up of the range herds.

There is no small difference between the cost of beef made on the free or cheap range and the beef fed on 60-cent corn.

BEEF PRODUCED ON HIGH-PRICED LAND.

There must be taken into the reckoning also the difference between the value of the range acre and the farm acre; also the increased value of the farm acre. Investigations by the Department of Agriculture have established a value per acre, including improvements, for farms of a medium sort in the North Central States in 1905, which was an increase of 35.3 per cent in five years. For the Western division of States the value per acre in 1905 was a gain of 40.2 per cent in five years. These are the groups of States that produce the bulk of the beef supply, and the value of farm land in them has subsequently risen above the figures given for 1905.

The increase in the value per acre of medium farms from 1900 to 1905 was 37.4 per cent in Illinois; 42 per cent in Missouri; 70.6 per cent in North Dakota; 65.2 per cent in South Dakota; 54 per cent in Nebraska; 54.7 per cent in Kansas; 44.5 per cent in Montana; and 81.3 per cent in Wyoming.

More profitable crops have made more valuable land, and cheap beef is not the product of high-priced land.

The settler on the dry farming and irrigated tracts where cattle once grazed is thus far not filling the gap in beef production on the range. The new settler must first give his attention to quick cash crops.

DIMINISHED MARKETINGS OF CATTLE AND HOGS.

The Bureau of Animal Industry gave post-mortem inspections to 7,621,717 cattle in the year ending June 30, 1907; to 7,230,272 cattle in 1908; and to 7,325,337 cattle in 1909, embracing all cattle killed for interstate shipment.

Along with the shrinkage in the supply of beef cattle there has been an increased slaughter of calves, thus augmenting the decrease in cattle supply. The inspections of calves after slaughter numbered 1,763,574 in 1907, 1,995,595 in 1908, and 2,046,713 in 1909.

HOGS AND PORK.

With regard to hogs, high-priced corn must have its effect in high-priced pork. Added to this is the recent great reduction in the marketing of hogs. The inspections of 1907 were 31,815,900, of 1908 were 35,008,027, of 1909 were 35,427,321. These years ended June 30. But for the first nine months of the calendar year the receipts of hogs at the great markets fell from 14,603,700 in 1908 to 12,593,200 in 1909, or 13.8 per cent.

To the industrial disturbance of 1907 is ascribed one cause of the recent diminution in the hog supply. When the bottom fell out of the market late in that year farmers sold brood sows because they were regarded as unprofitable, and the breeding herds thus sacrificed have not been replaced.

Rising prices of beef and pork have strengthened the demand for mutton. The sheep inspected by the Bureau of Animal Industry numbered 9,681,876 in 1907, 9,779,940 in 1908, and 10,802,903 in 1909. Even goats have been affected, since their inspections grew from 46,067 in 1908 to 69,193 in 1909.

In view of the diminished supply of meat animals during the past year, as compared with the population, it is to be expected that stocks of what the commercial papers call "provisions" should be lower than they were a year ago. In 5 chief cities of large storage the stocks of pickled pork decreased from 48,038 barrels October 31, 1908, to 33,991 barrels a year later. Lard decreased from 84,193 to 31,973 tierces during the year and cut meats decreased from 140,853,793 to 89,472,276 pounds.

SUMMARY OF CONCLUSIONS.

The foregoing may now be concisely summarized in a few lines: (1) The production stock of cattle has been diminished by range abandonment; (2) new demands for corn on farms for beef production; (3) high price of corn; (4) high prices of all meat, partly because of high corn prices; (5) the production stock of hogs was reduced in 1907; (6) high farm-land values; (7) both supply and cost of meat production unite to raise meat prices; (8) for seventy years the production of meat has declined relative to population; (9) meat exports increased until 1906, after which they sharply declined; (10) there has been a decreasing meat consumption per capita; (11) increased per capita consumption of cereals, vegetables, fruits, and saccharine foods.

MEAT PRICE MOVEMENTS.

PLAN ADOPTED TO MAKE THEM COMPARABLE.

High meat prices being sensibly felt in the experience of consumers, there is widespread conjecture as to the proportion of the increase received by the various parties from farmer to retail dealer. The foregoing statement concerning factors and conditions of meat production has prepared the way for a critical examination of the price movement of animals and meats. For the purpose of making all things comparable in price movement, a common base is adopted in the manner following.

A period of years is determined upon, beginning with 1896, because that year marks the beginning of the present period of upward movement of average prices of all commodities. The average annual price of the first five years, 1896–1900, is adopted as a base line, or price level, represented by 100, with which the price of each year may be compared upon conversion into a percentage of the price level.

For instance, if the price level or mean annual price of fresh beef of a certain description during 1896–1900 is 7.5 cents and the mean price for 1908 is 9 cents, the price level, 7.5 cents, becomes 100, and the ratio of 9 cents to 7.5 cents is 120, so that the price of 1908 is 20 above the adopted price level.

Whether this computation is made for prices or for other data for the same period of years, all results are comparable one with another, and it is possible to determine, approximately, for illustration, whether the price of steers in Chicago has increased in greater or less degree than the price of fresh beef since 1896.

BEEF PRICES.

Before considering measures of comparative price movements in detail, it may be well to state and remember the measure for all commodities combined. The series of comparative prices index numbers that is adopted for this purpose is one that is everywhere accepted. With the average of the five years 1896–1900 standing for 100, the prices of all commodities reached their highest subsequent point in 1906, when they stood at 126.7; they fell to 116.9 in 1908; and rose to 122.6 in 1909.

NO INCREASE FOR CATTLE.

For cattle other than dairy cows, the annual statistics of the Department of Agriculture show that the latest farm price has fallen below the price level of 1896–1900, that level being placed at 100. The price of cattle for January 1 rose to 110.4 in 1901, descended to 83.9 in 1905, and rose to 93.5 in 1908, and to 96.9 in 1909. Perhaps the price will be shown to have risen to 100 in the investigation of the Bureau of Statistics next January, or to the average with which it began in 1896–1900.

To make certain that the import of the farm price of cattle as above stated is not a mistake for some unperceived reason, the prices of 2-year-old steers have been examined in the unpublished records of the Department of Agriculture. Beginning with a price level of 100 in the first five years of the present period of upward movement of prices, steers of this age reached the price represented by 135.9 in 1900, declined to 85.5 in 1905, and rose to 100.8 in 1909. This is for January 1 and for the United States.

Within the great cattle-feeding State of Iowa, closely related to the ranges, the price of 2-year-old steers reached as high a point as 133.8 in 1900, dropped to 87.2 in 1905, rose to 109.8 in 1907, again fell to 97.6 in 1908, and in the following year touched 103.7.

West Virginia is somewhat of a cattle-feeding State, but, unlike Iowa, depends more on grass than on corn. In this State the price of 2-year-old steers in 1908 is represented by 114.5, and in 1909 by 118.3; and in Tennessee, another grass State, by 105.7 in 1908, and 112.5 in 1909.

The average for the United States as a whole is determined by the corn-feeding States, and for January 1, 1909, as above stated, had barely been able to rise from the trough of 1905 and reach the price level of 1896–1900.

Without further examination it would thus appear that the farmer has not shared in the upward movement of beef prices, and in some degree this is true. The prices of cattle on the farm are ascertained by the Bureau of Statistics from reports from every township for January 1 of each year, and the averages are regarded as above suspicion. But this marks the beginning of the cattle-feeding period, before corn has been converted into beef. This sort of beef is the product of two raw materials—corn and an animal body in the "raw" state—and such is the animal represented in the farm prices of the Bureau of Statistics, an animal unprepared for Chicago.

SOME RETURN FROM CORN-FED BEEF.

With regard to the prices of beef cattle in the raw state, therefore, the farmer is in about the same position now that he occupied during the first five years of the present price movement. In the matured and finished state, however, his beef cattle have participated to some extent in the advancing prices, as the Chicago prices given below prove. In other words, the farmer has received some share of higher beef prices with respect to corn as a factor of beef making, but has failed to do so with regard to the raw animal. In Chicago, according to a financial authority, the price of the best native steers, expressed comparatively, is 136.4 in 1908 and 139.9 in 1909, the mean for 1896–1900 being represented by 100. Upon the same base line the price of choice to extra steers in the Bureau of Labor's annual reports on wholesale prices is 126.3 for 1908.

Export beef cattle are in a class by themselves to meet international competition. During the fourteen years under review their price was highest in the fiscal year 1897, for which it is represented by 111.4; it declined to 85.6 in 1904; and advanced without interruption to 101 in 1908 and to 104.5 in 1909.

The farm price of corn December 1, 1908, was 212.6, compared with the mean of the five years 1896–1900, and in 1909 the comparative number is 218.6. The matter may now be formally stated as follows:

Item.	Prices index number.	
	1908.	1909.
Two-year-old steers at the farm, not matured or finished, January 1	95.6	100.8
Best native steers, Chicago	136.4	139.9
Choice to extra steers, Chicago	126.3	....
Corn at the farm, December 1	212.6	218.6

It is assumed that the farmer has received his due share of the advance in the Chicago prices of steers; but if so, still he has failed to receive a return corresponding to the increased price of corn in the more recent years, and in these years he has failed to get any increase whatever for his raw animal, except the trace of a gain in 1909.

MARKET RECEIPTS OF CATTLE AND EXPORTS.

The receipts of cattle at Chicago, Kansas City, Omaha, and St. Louis progressed from 5,856,000 in 1896 to 8,170,000 in 1907; then there was a fall to 7,524,000 in 1908, and the number for 1909 will be still lower. The comparative number for the cattle receipts of 1908 is 124.5; for the population of the United States it is 119.3.

The year when the exports of beef were greatest in quantity was 1906, represented by the comparative number 122. Subsequently those exports declined, and the number representing 1909 is 69.7. The great decline in exports and the receipts of cattle at large markets in 1909 would seem to indicate a larger per capita consumption of beef following the industrial depression of 1907–8.

WHOLESALE PRICES OF BEEF.

Pursuing the inquiry another step, wholesale beef prices are to be examined. Their comparison, for 1908, is to be with native steers, represented by 136.4, and with choice to extra steers, 126.3.

One of the large packing-houses has favored the preparation of this matter by contributing the average price of fresh beef sold by it in New York for each of the ten years beginning with 1899. The average prices are between 7 and 8 cents a pound, except 8.52 cents for 1902, 6.97 cents for 1905, and 8.22 cents for 1908. A price level for 1896–1900 being obtained by comparison with prices obtained from other sources, the fresh beef of this packing-house was sold in New York in 1908 at an average price which is represented by 119.8, a lower relative gain than was made by the classes of steers before mentioned.

A trade paper devoted to the provision interests reports mean prices of common to fair native carcasses in New York for 1908, which are related to the price level of the first five years of the period as 129.7 to 100. For native steer carcasses in New York the comparative price for 1908 warranted by the reports of the Bureau of Labor is 120.1. The mean price of beef carcasses in 1908, reported by a commercial authority, is represented by the comparative number 123.7.

While these numbers permit no fine comparisons with the relative price numbers for the classes of steers that are represented by 136.4 and 126.3, respectively, it is apparent that fresh-beef prices have not increased in greater degree than steer prices have at Chicago. The mean export price of fresh beef in 1908 stands relatively at 118.5; in 1909, at 120.9.

The following statement brings together the foregoing comparisons in concise form:

Item.	Prices index number.	
	1908.	1909.
Best native steers, Chicago	136.4	139.9
Choice to extra steers, Chicago	126.3	....
All fresh beef sold in New York by large packing house	119.8	....
Native carcasses, common to fair, New York	129.7	133.6
Native sides, New York (another authority)	120.1	....
Beef carcasses, Chicago	123.7	....
Export price, fresh beef	118.5	120.9

CURED-BEEF PRICES.

There is no obtainable comparative cattle price at Chicago with which the index numbers for cured beef are strictly comparable. The class of cattle for which a comparative number is obtainable nearest to the classes that contribute the cured beef is the class of choice to extra steers already mentioned as being represented by 126.3 for 1908, and these numbers are higher than they would be if they represented the lower classes of cattle from which the cured beef is obtained.

The Bureau of Labor's mean wholesale prices for 1896–1900 being 100, the comparative price of extra mess salt beef for 1908 is 151.9; of western salt hams, 134; of tallow, 139.9. By the same process, with dependence on the reports of a commercial authority, salt family beef is 165 in 1908.

The general conclusion is warranted that cured beef has increased in price in greater degree than fresh beef has and greater than steers have.

The items for cured beef in the following table may be compared with steers and fresh beef in the preceding table:

Item.	Wholesale prices index number.	
	1908.	1909.
Extra mess beef, salt	151.9	....
Western salt hams (beef)	134.0	....
Tallow	139.9	....
Family beef, salt	165.0	154.8
Export price, salted or pickled beef	124.5	141.0
Export price, tallow	137.2	130.9

RETAIL PRICES OF BEEF.

The sole dependence for the series of mean retail prices of beef is the annual reports of the Bureau of Labor on this subject, ending with 1907. For 1908 and 1909 special investigation was made for this report.

Approximately the retail prices of fresh-beef roasts and steaks have increased relatively as the wholesale prices of fresh beef have, with a tendency of steaks to increase more than roasts.

Item.	Retail prices index number.	
	1908.	1909.
Beef, fresh:		
Roasts	122.0	132.2
Steaks	123.3	133.7

SUMMARY OF BEEF PRICES.

The prices of all commodities for 1908 are represented by 116.9 as compared with the price level of 1896–1900; for 1909 by 122.6. The general conclusion is that the relative increase of the prices of steers at Chicago and of wholesale and of retail fresh beef has been roughly the same, and considerably more than the combined prices of all commodities, while the farmer who has produced or matured beef has participated in the upward beef-price movement only through the corn that he has fed, and then not fully. His cattle, before corn feeding, stand where they did in the price level of 1896–1900, and the best of them for beef purposes have not gained much.

PORK PRICES.

INCREASE FOR HOGS AND CORN.

The situation with regard to hogs is more fair to the farmer than the cattle situation is, but still it is apparent that during the last three years the price of corn has been too high for the price of hogs.

Still continuing to represent the price level of 1896–1900 by 100, the hog may be followed from farm to consumer with regard to relative increase of prices. The reports of the Bureau of Statistics of the Department of Agriculture concerning the farm price of hogs January 1 each year, give these animals a standing of 147.3 for 1909, or far below the position of corn in relative price, which was 212.6 for December 1, 1908. Many of these hogs at the time of January 1 are more or less unfinished, and yet exhibit the relative gain in price on the farm that they do when matured with 60-cent corn, as shown below.

SLAUGHTER COST OF HOGS.

The average cost per 100 pounds of all hogs slaughtered at principal markets is indicated by 148.1 in 1908, about the same as the increase in farm price; yet they do not fully return to the farmer the price of the corn fed to them. In Chicago prime hogs are represented by the relative number 160.9 for 1908, according to a commercial authority.

WHOLESALE CARCASS PRICES.

The relative gain of carcasses in price is approximately the same as that of live hogs at the great markets. Compared with the price level of 1896–1900, the price of dressed hogs of 160 pounds in New York in 1908 stands at 145.7, and the carcasses of market pigs at Chicago at 148.4. For 1909 the comparisons stand thus: Hogs on the farm, 147.3; prime hogs at Chicago, 202.3; dressed hogs of 160 pounds in New York, 168.9; carcasses of market pigs at Chicago, 180.5.

When observed in tabular form the foregoing numbers exhibit some rough agreements in the price movements of hogs on the farm, at great slaughtering points, and of carcasses at wholesale. There are differences and irregularities due to differences in the descriptions of the animals.

RETAIL PRICES OF PORK.

The latest year for which the Bureau of Labor's retail index number for fresh pork can be given is 1907 and it is 141.7, or perhaps near enough to the relative wholesale number to indicate approximate agreement in price movement.

Item.	Prices index number.		
	1907.	1908.	1909.
Hogs on the farm, January 1	171.3	136.0	147.3
Cost of all hogs bought at great slaughter points	139.3	148.1	....
Prime hogs, Chicago	139.4	160.9	202.3
Dressed hogs, 160 pounds, New York	158.3	145.7	168.9
Market pigs, carcasses, Chicago	139.1	148.4	180.5
Fresh pork, retail	141.7	....	....

PORK PRODUCTS.

The wholesale prices of most pork products have exceeded the price of hogs, carcasses, and fresh pork, in rate of advance, and all obtainable items with regard to them are assembled in the following table, wherein the facts stated plainly appear:

Item.	Wholesale prices index number.	
	1908.	1909.
Pork:		
Mess	152.7	204.6
New mess (another authority)	179.3	226.3
Salt, mess (another authority)	161.1	....
Bacon, short:		
Ribs, smoked, Chicago	170.5	221.0
Rib sides (another authority)	150.8	....
Do	152.0	200.0
Clear sides	151.9	....
Hams:		
Smoked	113.9	120.7
Smoked (another authority)	122.5	....
Lard:		
Western steam	177.0	223.7
Prime contract	167.7	....
Export prices:		
Bacon	142.9	142.9
Hams	114.6	112.6
Lard	149.2	163.9
Pork (salted or pickled)	149.8	148.1

SUMMARY OF MOVEMENT OF MEAT PRICES.

FARMER'S CATTLE HAVE BARELY ADVANCED.

Starting from the continuous shrinking of the cattle-range area, and more especially the removal of fences a few years ago from the ranges owned by the United States, and from the development of dry farming, which has converted range land into farms in regions of low rainfall, range cattle have been transferred from pasture to feed lot on farms in undue numbers. This increased the demand for corn and helped much to raise its price. The excessive marketing of cattle provided the largest exports of beef and its products in the fiscal year 1906 that this country ever had. The depletion of the stock of breeding animals has gone so far that the people are now facing a much-reduced beef supply.

Coincident with the beef situation came the great fall in the prices of hogs late in 1907, when farmers sold breeding sows so as to diminish a line of unprofitable production. This procedure restricted the pork production with results that are now felt.

In the upward movement of beef prices under the circumstances described, the farmer has not shared equally with packer, wholesaler, and retail dealer. His raw cattle are barely as valuable as they were nine to fourteen years ago, and, had not the price of corn ascended to a high figure, perhaps he would not have shared in the least in higher beef prices. As it is, he is getting a share through feeding corn, but not as much on this account as the price of corn demands.

With regard to hogs the case is different. The farmer has received nearly his fair share of the higher prices of pork in the increased price of his unfed hogs, and he gets some of his due in the corn used for feeding. The price of corn has been too high for the price of pork.

From the moment that the price is paid for the steer or hog in the stock yards to the purchase of the meat and its products by the consumer there are successive additions to price in slaughtering, in wholesaling, and in retailing. The adjustments of these three business functions to one another with regard to their relative share in the final price have remained substantially the same since the period of 1896–1900, which constitutes the base line of this investigation. If the retailer has increased his price of beef and pork, so has the wholesaler and the slaughterer, all with some show of approximation to the same degree as the price of the animal has advanced at the stock yards.

RISING PRICES OF FARM PRODUCTS.

COMPARISON WITH OTHER COMMODITIES.

FARMERS' GAIN IS RELATIVELY GREATER.

The increased cost of living within recent years permits an inquiry as to whether farm products have increased in price in greater degree than other commodities have.

The comparison is preferable for the farm products for which farm prices are known as far back as the beginning of the present movement of advancing prices, which began in 1896. The method will be to take the mean price of 1896–1900 as the base on which the price of each year will be relatively established, this base or mean of the five years mentioned being regarded as 100. Then if the price of a given commodity in a given year is above the mean for the five years its increase will be expressed as above 100, as, for example, by 102; if below, perhaps by 97 or some other number under 100. By this procedure the relative position of the price of wheat on the farm may be directly compared with the prices of other commodities.

In 1909 the relative price of all commodities, according to a commercial authority, is expressed by 122.6, the mean of 1896–1900 being regarded as 100. Only one year, 1906, reached a higher point since 1896, and that was indicated by 126.7.

Among the farm animals, horses exceeded the other kinds in relative increase of farm price, the index number being 264.4; next are mules, with 235.1; swine, with 147.3; and sheep, with 147.1. Cattle are below 122.6, the number for all commodities, milch cows being represented by 120.4 and other cattle by 100.8.

The weighted average for all live stock is 193.1.

All crops for which a farm value per bushel or other unit is known are above the relative increase of price of all commodities. The price of corn per bushel stands at 218.6 in 1909, compared with 100 for the mean of 1896–1900, and no other crop, as far as known, has risen as high, although oats reached 209.6.

Third in order are potatoes, with 192.4; then follow wheat, with 166.2; rye, 162.1; buckwheat, 161.9; tobacco, 161.4; barley, 147.3; cotton, 138.4; hay, 122.9.

All of the foregoing crops may be combined for an average, and this average, which has been weighted, is 180.9. For live stock the average, as previously mentioned, is 193.1. For the crops particularized and live stock combined the representative number is 186.9. This is an average that is weighted according to the values of the various crops and classes of animals. It has not been equaled during the price period under review beginning with 1896. Neither total animals nor total crops have equaled their relative price number for 1909. Animals nearly did so in 1907, for which year their relative number was 191.1, or only a little under the 193.1 of 1909. The average for all crops has at no time been nearer to the 180.9 of 1909 than 172.9 for 1908. In 1907 the relative price number for all crops was 166.7; in 1906 it was 134.6; for 1905 it was 135.6; in 1904 it was 136.9; in 1903 it was 142.2; in 1899 it was 103, and in 1896 it was 90.1, for which year the number representing all commodities was 87.1. Live stock had the representative number of 90.5 for 1896, and crops and live stock combined a weighted average of 90.3.

It is apparent that there has been a tendency of animals and crops of the farm to increase in value per unit at a faster rate than all commodities have increased.

FARM PRODUCTS AND FOODS IN WHOLESALE PRICES.

Some confirmation of this conclusion may be obtained by comparing the farm products with other commodities within the field of wholesale prices, that is, after these products have left the farm and have been more or less manufactured or prepared. The Bureau of Labor's investigations of wholesale prices afford materials, and the prices of 1896–1900 stand for 100; the latest year is 1908.

In that year the average for all commodities had the relative number 126.4, with which may be compared the number 141.9 for farm products, 128.7 for foods after they have left the farm, 121.9 for cloths and clothing, 125.3 for fuel and light, 124.9 for metals and implements, 132.8 for lumber and building materials, 106 for drugs and chemicals, and 119.5 for house-furnishing goods.

In wholesale trade, therefore, farm products exceed all other classes of commodities in relative increase of price since 1896, and food is exceeded only by farm products and by lumber and building materials.

The prices index numbers of a prominent commercial authority afford another opportunity within the field of wholesale prices to compare farm products and foods with other commodities, the latest year being 1909. All commodities have the relative price of 122.6, compared with 100 standing for the mean price of 1896-1900. Wheat, corn, oats, rye, and wheat flour are represented by comparative price numbers that are far above the 122.6 for all commodities, but barley, after being above for the two preceding years, has fallen to 110.2. Beeves stand at 139.9, hogs at 202.3, and horses at 228.8, while sheep are low at 110.7. Beef carcasses are at 122.6, or the average for all commodities, while pork and mutton carcasses and all meat products are far above.

Milk at New York is represented by 129.8, eggs by 205.1, creamery butter by 151.7, factory cheese by 145.3, salt mackerel by 108.2, and codfish by 153.1. Below the average are found coffee at 110.1, granulated sugar at 87.2, tea at 74.7, New Orleans molasses at 81.6, fine salt at 100.9, and rice at 100.6; but beans are represented at 163.4, peas by 146.8, potatoes by 152.2, and apples by 190.8. Ohio and Pennsylvania wool is placed at 137.3 in the scale of relative prices, or considerably above the general average of 122.6; native steer hides are at 167.9, and Burley tobacco at 177.5.

In the prices index numbers now under consideration the grouping of somewhat similar commodities into classes was not done before 1898, so that for the purpose that follows the mean of 1898–1900 is adopted as the base price level represented by 100. The number for all commodities then becomes 115.2. For the class of breadstuffs the representative number is 155.8; live stock, 165; provisions, 127.1; fruits, 90.1; hides and leather, 126.1; textiles and metals, each 107.7;

coal and coke, 107; oils, 122.5; naval stores, 104; building materials, 87.6; chemicals and drugs, 84.

The general fact is that in the upward movement of prices since 1896 the products of the farm have fared better than any other class of commodities, the only large item that is an exception being unfed beef cattle, the farm price of which has now barely begun to rise above the price level of 1896–1900 for beef cattle.

WORK OF THE DEPARTMENT IN 1909.

ENFORCEMENT OF THE FOOD AND DRUGS ACT.

The Food and Drugs Act locates in the Bureau of Chemistry the examination of specimens of foods and drugs for the purpose of determining whether such articles are misbranded or adulterated. In all other respects the law speaks to the Secretary of Agriculture, who under the act is charged with its enforcement. The advisory work is intrusted by the Secretary to the Board of Food and Drug Inspection and the Referee Board of Consulting Scientific Experts. The legal work is in the hands of the Solicitor of the Department of Agriculture.

CHEMICAL WORK.

Samples of suspected foods and drugs are collected in the course of interstate commerce by a force of inspectors connected with the Bureau of Chemistry, who also make sanitary inspections of factories. Samples of imported products are obtained through the agents of the Treasury Department.

The samples collected are first examined in the branch chemical laboratories, of which there are 21, situated at important ports of entry and commercial centers throughout the country, as follows: Boston, Buffalo, Chicago, Cincinnati, Denver, Detroit, Galveston, Honolulu, Kansas City, Nashville, New Orleans, New York, Omaha, Philadelphia, Pittsburg, Portland, Oreg., St. Louis, St. Paul, San Francisco, Savannah, and Seattle. At these laboratories, also, preliminary hearings are accorded the manufacturers and dealers concerned. When these examinations indicate that the product in question fails to comply with the law, the samples are forwarded to Washington, where another analysis is made in the Bureau of Chemistry, and opportunity for a full hearing before the Board of Food and Drug Inspection is accorded. When in any case the Board is satisfied that the law has been violated, the facts are reported to the Solicitor, who prepares the papers in the case for transmission to the Department of Justice, by whose officers the prosecution is conducted before the proper United States court.

Following this procedure about 1,300 factories were inspected during the year. About 15,000 samples of foods and drugs passing in interstate traffic were taken, of which 9,631 were submitted to examination in the branch laboratories, with the result that more than 2,000 were forwarded to Washington and reexamined in the Bureau of Chemistry. Of imported products the branch laboratories examined 8,476 samples, about 2,500 of which were sent to Washington for reexamination. In addition, more than 79,000 samples of imported goods were submitted to floor inspection at ports of entry, without examination in the laboratory. Preliminary hearings to the number of 6,901 were conducted at the branch laboratories.

ADVISORY WORK.

In the enforcement of the Food and Drugs Act this Department has to do with two classes of foods and drugs; first, those which enter interstate commerce or are sold or manufactured within the District of Columbia or the Territories, and, second, those offered for import into the United States at the various ports of entry.

After an examination of samples of suspected foods and drugs has been made by the Bureau of Chemistry the report of that Bureau is given to the Board of Food and Drug Inspection. If it appears to the Board that there has been a violation of the provisions of the food law, citations are issued to the person from whom the samples were purchased in order that he may appear and give evidence as to the facts in the case. As a matter of courtesy hearings are always granted every person who may have an interest in the case. Such hearings are always private.

The Board can not personally attend every hearing, except such as are held in the city of Washington. Hearings are granted at points where the branch laboratories of the Bureau of Chemistry are situated and are always held at such laboratories nearest and most convenient to the person cited. After the evidence has all been collected the cases are again considered by the Board, with the result that they are either dismissed, placed in permanent abeyance, or submitted to the Solicitor of the Department for the preparation of the cases in legal form. These cases then come to me for my final consideration as to whether or not they should be referred to the Department of Justice for prosecution.

Many of the questions which have come before the Board for consideration are exceedingly perplexing, and it has often been necessary to hold public hearings, at which anyone interested in the subject under discussion has an opportunity to appear and present such evidence as is deemed pertinent to the question. This plan has always been pursued by the Board in the consideration of large questions, and in nearly every case, as the result of the hearings, formal decisions have been issued. Since the law was passed more than seventy food-inspection decisions have been issued for the guidance of those interested in the food law and the rulings under it. These decisions have no judicial force; they are merely statements of the Department's views and policy, and after their issuance it is customary to allow sufficient time to elapse before they are put into effect.

Under section 3 of the law the Secretary of the Treasury, the Secretary of Agriculture, and the Secretary of Commerce and Labor are empowered to make uniform rules and regulations for its enforcement. On October 16, 1906, what is known as Circular 21 of the Office of the Secretary was published. This contains the "rules and regulations" for the enforcement of the Food and Drugs Act. As experience has been gained in the enforcement of this law, necessity has arisen for adding to and amending the rules and regulations, and since the issuance of the first edition of Circular 21 ten rules and regulations have been promulgated by the three secretaries above mentioned. Some of these regulations are modifications of those already existing, while others deal with new subject-matter.

Attention might be called here to the public hearings which have been held, because they are important as showing the method of getting in touch with the manufacturers so as to have full information prior to the rendering of decisions. For example, the bleached flour hearing took five days for its completion, and the evidence given was very full. As a result of this hearing a decision on the subject was rendered by the Department. At the present time the matter is in the courts because of manufacturers who have not been willing to accept the views of the Department. It is expected that before long the question will be settled by the courts. Attention should be drawn also to the public hearing which was given on the labeling of mineral waters. This was very largely attended, and after mature consideration of the evidence submitted a decision was given expressing the opinion of the Department as to the proper labeling to be placed on beverages of this type. General hearings were given also on the subjects of the labeling of yeast, weights and measures, labeling of chocolate and cocoa, oysters, New Orleans molasses, alum, etc.

It has been my observation that the manufacturers and jobbers have appreciated the efforts of the Department to obtain full information before the issuance of decisions, and in general it may be said that practically no complaint has been received after the decisions have been issued, and they have been quite generally complied with. In this way the law has been administered without undue harshness, and yet the results which it is the object of the law to attain have been and are being obtained. It is not the desire of the Department to make this law an instrument of oppression, but rather to get good results by the means indicated. In no case, so far as known, has the Department reported for prosecution cases against others than the persons who were originally responsible for the adulteration or misbranding; that is, it has been my desire to put the responsibility nowhere else. It is only by going to the fountain-head that the results can be obtained. No good can be obtained by prosecuting the middleman.

"Adulteration" is an ugly word in the popular mind. It carries with it the idea that there is grave danger to the public health when adulterated foods are consumed. This may or may not be true. Under section 7 of the Food and Drugs Act, adulterants are of two kinds, namely, (1) those which may be injurious to health, and (2) those which are not unwholesome but which debase the character or value of the food. Adulteration of the latter type wholly disappears when the foods are properly branded so that the consumer knows exactly what is being purchased. The question of the effect on health of "preservatives" in foods is in many instances very delicate. There is apparently but one way in which questions of this kind can be properly decided, and that is by means of experimental work. In some cases there appears to be a very marked difference of opinion among men who might be presumed to have the right to speak with authority on questions of this kind. The Department has therefore pursued the policy of submitting these large matters to what is called the "Referee Board of Consulting Scientific Experts," the personnel of which is such that the results obtained by them must of necessity carry conviction. This Board was first organized shortly after the pure-food law went into effect, and the members were chosen by ex-President Roosevelt after correspondence with the heads of a large number of the most prominent universities of the United States, and on his suggestion the men were appointed by me. The board at present consists of the following members: Ira Remsen, president of Johns Hopkins University; Russell H. Chittenden, director of the Sheffield Scientific School, Yale University; Alonzo E. Taylor, University of California; C. A. Herter, College of Physicians and Surgeons, New York; and John H. Long, Northwestern University, Chicago. Several of the larger questions have been referred to this Board, but as yet only one has been reported upon, namely, the effect upon health of sodium benzoate. This report is published by the Department as Report 88 and comprises 784 pages, in which all the details of three separate sets of feeding experiments are given. Clinical details are given and in fact all such data as were used in reaching the conclusions. This report describes probably the most extended experiment of its kind ever undertaken in any country. Based upon this report, the Secretary of the Treasury, the Secretary of Commerce and Labor, and myself, who are empowered by the act to make rules and regulations for its enforcement, promulgated Food Inspection Decision 104, which states that benzoate of soda may be used in foods, provided the amount used is clearly stated upon the container or package of food containing this substance. To the Referee Board there has also been referred the effect of sulphur dioxid, of saccharin, and of sulphate of copper on health, the latter being the substance ordinarily used in the greening of vegetables, many of which are being offered for entry into the United States. This Board is now engaged in the work submitted to it, and it is expected that reports will be received shortly on some of the questions which are now in its hands for experimentation and investigation.

In accordance with the rules and regulations for the enforcement of the act, where cases have been sent to the courts and judicial opinions have been rendered, such opinions are published by the Department not less than thirty days after being given. Considerably more than one hundred of these court decisions under the name of "Notices of Judgment" have been issued by the Board of Food and Drug Inspection, and there are a number in the course of preparation. These notices of judgment appear to be carefully considered by the manufacturing interests. They contain the views of the courts on important points, and thus may serve as a guide, as in the case of the food inspection decisions.

The Department has carefully scrutinized the foods and drugs offered for entry at the various ports of the United States, with marked results. New York is the port at which perhaps 75 per cent of the foods and drugs are entered, and next in line comes Boston. There has been little difficulty in the enforcement of the law at the various ports on the whole. It may be said, however, that in some lines the entire character of products offered for entry has been changed, and products of a much higher grade are now imported. For example, it has been customary in the past for all case goods of edible oils, wines, liqueurs, distilled spirits, etc., to have marked on the outside not only the number of bottles or cans contained in the case, but also their contents. Examination has shown that such marking of contents has been very largely incorrect, but at the present time, through the work of the Department, very few, if any, fraudulent and misbranded cases are offered for entry. Olive oils are now offered at the ports of such a character that it is rare that one containing other oil is found.

Recently, importations of figs have been investigated. Information secured by the Department indicates that many of the packing houses in which figs have been packed in foreign countries are very insanitary and unhygienic, and that the products of these establishments constitute a distinct menace to the public health. In order to rectify these conditions no figs are now allowed entry into the United States unless accompanied by a certificate properly viséed by one of our American consuls, indicating the character of the conditions under which the packing has taken place. This does not of itself, however, secure immunity against inspection; on the contrary, figs which had been packed under sanitary conditions have been refused entry by the Secretary of the Treasury because of their wormy and moldy condition. As a result, the people of the United States are now receiving a clean and wholesome product, packed under proper conditions.

With the American people the term " cheese " has come to mean a product which is made from whole milk. A general inspection has been made at the various ports of the character of the cheeses offered for entry, and it has been found that a large number of the so-called cheeses have been made from milk from which a greater or less amount of the butter fat has been removed. The product made from such skim milk is properly called " skim-milk cheese," and all such cheeses offered for entry are now branded as " skim-milk cheeses," or in some way so as to indicate that skim milk has been used in their preparation.

It should not be understood, however, that cheese made from skim milk is unwholesome or lacking in food value. In fact, in the preparation of certain types of cheese, the removal of more or less of the fat from the milk is essential. It is, however, desirable for the consumer to know whether the cheese is made from whole milk, and this is accomplished by proper labeling.

The Federal food law has proved of value to some of our large cities in raising the quality of milk furnished. Watering and skimming of milk has been found altogether too common, nor is it unusual to encounter milk obtained under insanitary conditions and then improperly cared for. A number of milk crusades have been held and the results have been gratifying. These will be continued from time to time as conditions seem to warrant. Too much care can not be given to improving the standard of this most important of foodstuffs.

One of the most flagrant violations of the Food and Drugs Act was the shipment of coffee coated with a mineral poison—lead chromate. Eighty-four sacks of this coffee were seized and destroyed by order of the court. Criminal proceedings were brought against the shipper of this poisonous coffee and a fine was imposed.

Under section 7 of the law, confectionery containing mineral matter is considered adulterated. Action has been taken against the use of metallic silver as a coating for dragées, which are largely used as a confection. The courts have sustained the Department and the case has been appealed by the defendants. Confectionery is a class of foodstuffs which must at all hazards be kept wholesome and pure.

Very few cases of the use of questionable preservatives are now encountered at the ports. Salicylic acid, boric acid, fluorides, and similar substances have practically disappeared from foodstuffs offered for entry, as well as foodstuffs manufactured within our borders and offered for interstate commerce. This result is especially gratifying because accomplished without recourse to the courts. It is true, however, that with respect to boric acid there are a few firms who have held out against the decision of the Department, but cases affecting them are now pending in the courts and it is expected that a judicial decision for our guidance will soon be given.

The correspondence of the Department relative to vexatious questions still indicates that the public are not yet fully informed concerning the law and its requirements. Wherever it is possible in the answering of the inquiries, information is given for the guidance of those making inquiry. It is not within the authority of the Department to point out exact methods of labeling, although as much information is given as can properly be extended.

Too great importance can not be attached to the character of the work done at the ports in controlling the drugs coming to this country. Very often the drugs are such that the Secretary of the Treasury, with whom I cooperate in the Board work for detentions, orders reexportation, as he has authority to do under section 11 of the Food and Drugs Act, where the products detained may be of such character as to prove dangerous to the health of the people of the United States. To illustrate: Certain Chinese pills are offered for entry as being remedial in cases of persons afflicted with the opium habit. Examination of these pills has shown that they contain material quantities of opium or morphine, and without doubt such products are of a fraudulent character and as remedial agents for the opium habit are absolutely dangerous. Crude drugs from which remedial agents are to be prepared have been rejected where the remedial agent prepared therefrom was not of a character capable of being standardized, and when the crude drugs are weaker than prescribed by the United States Pharmacopœia. As a result of this drastic but absolutely necessary action the character of the crude drugs offered for importation has been very materially improved, and exportation is not resorted to as frequently as formerly.

The character of the shipments of drugs is scrutinized, and when false or misleading statements are found the circulars are removed or destroyed.

At the beginning of the inspection at the ports it was found that too much time was consumed in the handling of import cases. This difficulty has been overcome by the establishment of "precedents."

It was found that there were many recurring cases of a similar type which the Department had to consider, and as soon as the line of action had become sufficiently settled I suggested to the Secretary of the Treasury that a similar line of action would be pursued by this Department when dealing with like cases. The Secretary of the Treasury has cooperated in such cases, and instead of the final action being taken in Washington they are now expedited by direct communication between the representatives of the Department of Agriculture and the Treasury at the ports of entry. This has very greatly minimized the time necessary to deal with certain classes of imports, and as conditions seem to warrant these precedents are increased in number so as to further expedite the work. This change has proved most satisfactory to the importers, but has in no way lessened the efficiency of the work.

LEGAL WORK.

There were reported through the Solicitor to the Attorney-General and United States attorneys 494 cases of violations of the Food and Drugs Act, 359 more than were so reported during the previous year. Eighty-five cases resulted in conviction and fines of $2,002, with costs of about equal amount; 98 cases resulted in decrees of condemnation and forfeiture of many tons of goods, both foods and drugs; only 2 cases were lost by the Government; 2 seizure cases are pending on appeal to the circuit court of appeals; 135 cases were dismissed; 53 civil, 74 criminal, and 42 seizure cases were pending in the courts at the close of the year. Many of the 135 cases dismissed were accompanied by mitigating or palliating circumstances which caused the Department to recommend their discontinuance.

Among the cases reported and successfully prosecuted during the year were upward of 75 cases involving the adulteration of milk and cream, shipped from outlying districts to St. Louis, Kansas City, Cincinnati, and Chicago. This crusade has resulted in the material purification of the milk supply of these cities. A number of the more pernicious nostrums, extensively advertised and sold as cures for cancer, diphtheria, skin diseases, headaches, etc., have been excluded by successful prosecutions from interstate commerce, and substantial progress has been made in the improvement of the quality of flavoring extracts.

The question of the constitutionality of the act was decided in the western district of Missouri, the court sustaining the validity of the act.

A writ of mandamus to compel the Secretary of Agriculture to withhold the recommendation of prosecutions against manufacturers and shippers of flour bleached by a certain process using nitrogen peroxid was denied by the court, and the decision was approved by the court of appeals of the District of Columbia.

There were published during the year 66 notices of judgment, provided for by section 4 of the Food and Drugs Act. The demand for these notices is great, and it is apparent that manufacturers and dealers are closely watching the operation of the law.

OTHER LEGAL OPERATIONS OF THE DEPARTMENT.

The Department has continued, through the Office of the Solicitor, the enforcement of the Food and Drugs Act, the Meat-Inspection Law, the Twenty-eight-Hour Law, and such other laws and regulations as come properly under the jurisdiction of this Department. Prosecutions for violations are being vigorously carried out through the United States attorneys. This work has steadily increased, and the year ending June 30 last showed an increase over any previous year. The preliminary investigation and gathering of data necessary to perfect these cases for action in the courts has been carried on in the Office of the Solicitor, as well as the large volume of correspondence with United States attorneys relative to the maintenance of the cases in the courts. Briefs covering constitutionality, construction, and interpretation of the several laws committed to the Department for administration and enforcement have been written by the Solicitor at the request of the United States attorneys for use in contested cases, and almost daily advice and suggestions have been given United States attorneys in response to their requests for such assistance.

FOOD AND DRUGS ACT.

The legal work under this statute has already been discussed in connection with the chemical and advisory work necessary to its enforcement.

THE TWENTY-EIGHT-HOUR LAW.

In addition to 828 cases pending at the beginning of the year, there were 208 cases of violation of the Twenty-eight-Hour Law reported during the year, a decrease from the previous year of 477 cases, or 70 per cent. Penalties were collected amounting to $73,490 and costs $11,539.85, an increase over the previous year of $11,960 and $4,338.14, respectively. Of cases decided, only 33, or about 5 per cent, resulted adversely to the Government. The law has been vigorously enforced, and the decrease in the number of cases reported is gratifying evidence that the railroads are now complying in an appreciable measure with the requirements of the act.

The much-discussed question of what constitutes the unit of violation may be considered as finally settled, the decisions of several Circuit Courts of Appeals affirming the contention of the Department that each separate shipment constitutes an offense.

In practically all cases in which an interpretation of the meaning of the act was submitted to the courts the decisions have favored the contentions of the Government.

Bills have been introduced in two Congresses requiring the railroads to maintain a 16-mile rate on stock trains, but they have thus far failed of passage. It is believed that such a law would greatly facilitate the safe and humane transportation of animals in interstate commerce.

VIOLATION OF GAME LAWS.

Only one case was reported to the Attorney-General under the Lacey Act. It has been difficult to secure direct evidence sufficient to convict, but it is believed that under the law as amended to take effect in January next it will be possible materially to lessen the offenses now committed.

Four cases were consolidated against one person and resulted in the imposition of a fine of $400.

SUPPRESSION OF CONTAGIOUS DISEASES.

Nine cases of violations of the act for the suppression of contagious diseases among domestic animals were reported to the Attorney-General, and four remained unsettled at the end of the preceding year. One resulted in a fine of $100; eight were pending at the close of the year; two were dismissed; in one the grand jury failed to indict; and in one the defendant was discharged on preliminary hearing.

OFFENSES AGAINST THE QUARANTINE LAW.

Thirty-three cases of violations of the quarantine law were reported to the Attorney-General and five remained unsettled at the close of the previous year. Four cases resulted in fines of $300 in one, $100 in two, and in one $100 with a commitment to jail for thirty days; one resulted in acquittal; the grand jury failed to indict in three; one was withdrawn; and twenty-nine were pending at the close of the year.

The law is working admirably and has already accomplished beneficial results far in excess of the most sanguine expectations.

MEAT INSPECTION.

Only 44 cases of violations of the Meat Inspection Law were reported. These offenses are almost invariably committed by individuals and rarely by large establishments. There were fifteen convictions, seven dismissals for lack of evidence, and the rest were still pending at the close of the year.

CONTRACTS AND LEASES.

During the year 702 contracts and leases were prepared and examined, many of such a nature as to require unusual care and skill in their preparation.

NEED FOR FEDERAL INSPECTION OF INSECTS AND NURSERY STOCK.

In January, 1909, the authorities of the State of New York informed the Department that the brown-tail moth had been found in that State in shipments of seedlings received from Angers, France. Later it was learned also that the winter nests of this pernicious moth had been found in Ohio, on seedlings imported from the same French locality. By arrangement with the Treasury Department and the principal railroads, the Department was then promptly notified of the final destination of all cases of plants received, and was thus enabled to notify state inspectors or other competent persons near the destinations. Notices of nearly 800 shipments, divided among 35 States, were thus sent out. In 15 of these States nests of the brown-tail moth were found. Proper inspection was probably had in all cases, and it is likely that this concerted effort to prevent a new introduction of the brown-tail moth was for the time successful.

Under our present laws, however, these shipments might easily have been overlooked, and the considerable expenditures which for several years we have been making in the warfare against the brown-tail moth would then have been to no purpose. Moreover, unless additional legislation is secured, we are in constant danger of such introduction of pernicious insects from abroad. We can not depend upon the inspection systems of foreign countries. These may be rigid in one country and lax in another, or in any country there may come a period of laxity during which insect pests destined for this country may escape detection. Neither can we depend upon the law now on the federal statute books which prohibits transportation companies from "knowingly" bringing into this country, or carrying from State to State, any insect which is "notoriously injurious." Although this law also forbids the conveyance of "notoriously injurious" insects in the mails, it is nevertheless insufficient, and there is, besides, no provision for its enforcement.

What we need is a federal statute which shall not only forbid the importation or interstate transportation of injurious insects in all stages, with adequate penalties for its violation, but also provide for a thorough system of inspection and quarantine, at ports of entry, for nursery stock and other materials on which such insects may be imported, as well as a sufficient means of control of interstate transportation of such materials. Such an inspection, in conjunction with the admirable systems now in existence in the States, would provide the country with a reasonable degree of protection against additional introductions of insect pests.

CHANGES IN THE PERSONNEL.

The total force of officers and employees on the rolls of the Department July 1, 1909, as shown by the report of the appointment clerk, numbered 11,140, a net increase of 720 during the fiscal year. The force employed in Washington numbered 2,317, and 8,823 were employed outside of Washington. During the year 24,494 appointments of every description were made. Of these, 16,938 were in the manual-labor grade, for temporary employment in the fields and forests and at stations outside of Washington, the appointments being for short periods, usually averaging three months. The number of persons receiving probationary appointments, equivalent to absolute appointment if retained in the service after the probationary period, was 1,492. There were reinstated 52, and transferred from other Departments 61. During the year there were 511 resignations and 38 deaths, while 53 were separated from the service for misconduct. On July 1, 1909, there were 1,237 employees on the statutory roll (positions specifically provided for by the act of Congress making appropriations for the Department), and 9,903 were paid from lump-sum appropriations. The large number of emergency appointments is made necessary by the varied experiments, demonstrations, meat and food inspection, work on the National Forests, extinction of injurious insects, etc., where temporary help is required.

WEATHER BUREAU.

SCIENTIFIC INVESTIGATIONS AND FORECASTS AND WARNINGS.

The scientific investigations of the Weather Bureau have been carried on successfully at the Mount Weather Research Observatory during the year. Additional knowledge of conditions in the upper atmosphere has been gained by means of kites and captive balloons, which have been sent into the upper air with instruments for recording the conditions of temperature, moisture, and winds at varying altitudes. The heights attained in these flights were greater than in the preceding year, but still greater altitudes are desirable in order to complete the needed series of observations.

These upper-air observations have been used with benefit in weather forecasting for the Atlantic Coast States, the atmospheric conditions at elevations of 8,000 to 10,000 feet having been found to bear definite relations to weather changes that subsequently occur at the surface of the earth in this region. For instance, it has been found that the average wind direction at Mount Weather at about 10,000 feet above sea level is northwest, and that shifts of wind to west and southwest usually forerun by about two days the beginning of rain on the middle Atlantic seaboard. Continued observations will doubtless reveal other conditions a knowledge of which may prove of positive value in practical weather forecasting.

It is proposed to supplement the Mount Weather flights with others obtained through the liberation of free balloons during the coming year. On account of its proximity to the ocean, the research station will not be the scene of these flights; they will be made in the interior portion of the country, some of the balloons being liberated near a storm center and others sent up simultaneously some hundreds of miles to the eastward. Another line of experiments will be conducted at high stations in Nevada or Colorado, for the purpose of determining the changes in the atmosphere in a vertical direction.

Eight ascensions have so far been made, in each of which the altitude attained by the free balloon equaled or exceeded 10 miles. On October 12, at Omaha, Nebr., a height of 15 miles, hitherto unprecedented for this country, was attained, and on October 6, at Indianapolis, Ind., a height of nearly 14 miles was reached. The last-named ascension was made in almost the center of a great area of high pressure. The balloon was observed to move in a southwesterly direction at all altitudes, and was later found in that direction about 30 miles from the city. A similar movement—that is, a drift of the air at high altitudes toward the southwest—was observed at Omaha, Nebr. This would seem to indicate that the control of the general atmospheric movements exerted by areas of high pressure extends upward to greater altitudes than has hitherto been suspected.

In general, the results of the ascensions so far as available are in close accord with European observations. The great isothermal layer was reached on eight occasions; its lower limit varied greatly in altitude from day to day and for different surface weather conditions.

Measurements of the intensity of solar radiation and the polarization of sky light have been made at Mount Weather and at Washington during the year. Recent studies of this character have deepened the conviction that there is a relation between these manifestations of solar energy and weather conditions, and the Mount Weather Observatory is cooperating with foreign observatories in attempts to find out more definitely the nature of this relation. Magnetic observations have also been continued, and data of magnetic storms, auroras, and sun spots collected.

All of these observations have to do with securing a better knowledge of the conditions in the air far above the earth's surface, and the facts obtained are to be studied with a view to determining their relation to subsequent weather changes at or near the surface. The data thus collected, as well as the discussions thereof, appear regularly in the Bulletin of the Mount Weather Observatory, a periodical publication almost wholly devoted to the meteorology of Mount Weather.

In addition to its daily forecasts, the Weather Bureau has issued forecasts for about a week in advance, as conditions warranted, from time to time. In practically every case these long-range predictions have met with a high degree of verification. On July 9, 1908, a forecast of a warm wave was issued some days in advance of its expected occurrence, and it was announced at the same time that it would be succeeded by much-needed rains in the Ohio Valley and Middle Atlantic States. The warm wave that followed was the most intense of the summer of 1908, and the rains came after as predicted. Similar forecasts of drought-relieving rains, tropical storms, frosts, and cold waves were followed by the conditions expected. These forecasts have been made possible through the additional information obtained from upper-air observations and by means of a system of observations covering the entire northern hemisphere.

KEY WEST HURRICANE.

In looking for single instances of important service rendered by the Weather Bureau the best illustrations will perhaps be found in its advance warnings of the destructive storms that from time to time visit the Atlantic and Gulf coasts. This generally accepted truth has received fresh confirmation in the history of the Key West hurricane of October 11, 1909. From the time this storm was first definitely located over the south-central Caribbean Sea, on the 6th, until it crossed the southern extremity of Florida and passed into the ocean, on the 11th and 12th, the Weather Bureau gave out daily advices regarding its intensity and the direction of its movement at every stage of its progress. The Bureau ordered storm warnings at the southern Florida coast stations on the 10th; at 6 a. m. of the 11th these were changed to hurricane warnings at Key West and Sand Key, and a special bulletin followed, giving a full account of the dangerous conditions then existing and describing the probable future course of the storm. Shipping in the affected area had already been warned to seek refuge.

Under orders from the Key West official the Weather Bureau men at Sand Key left their station for the light-house near by, where they continued observations during the storm. At the time the station was abandoned the wind was blowing at a rate of 75 miles an hour. An estimated velocity of 100 miles an hour was reached later, and at the height of the storm the island was covered with water. At 10.30 a. m. the Weather Bureau building was swept into the sea.

At Key West the barometer fell to 28.50 inches at 11.45 a. m., the lowest reading ever recorded at the station. Between 11 a. m. and

4 p. m. the wind velocity ranged from 68 to 76 miles an hour. During this time hundreds of buildings were blown down, many vessels were swept from their moorings, and some were wrecked, and at least six lives were lost. The total financial loss at Key West is estimated at $2,000,000 to $3,000,000.

After passing Key West the hurricane swept the Florida peninsula south of Miami. The damage between the two points is said to have aggregated millions of dollars, and 11 deaths are reported. Additional loss of life undoubtedly occurred among the fishermen and spongers and those dwelling on the low-lying islands or keys that fringe the coast of the southern Florida peninsula, since they were outside the zone of communication. Protective measures following the receipt of warnings reduced losses both of life and of property to a minimum, however, wherever the information could be given. The preparations made by the East Coast Railroad officials unquestionably saved hundreds of their employees from death. About 3,000 men were engaged on their construction works, but were withdrawn from their exposed position to places of safety upon receipt of the warnings. The vice-president of the line says:

> Positively not a life was lost in the storm. Very little damage was done to the right of way or to work on the extension. The road will be open to traffic within a few days to Knights Key. Warning by the Weather Bureau enabled us to fully protect all employees and equipment.

Three years before these same extension works were visited by a storm of less intensity than the one just experienced. Although warnings of its coming had been given, its arrival found the men unprepared; the high winds blew the boats in which they were quartered out to sea, and more than a hundred were drowned. As the recent storm was more severe than its predecessor, it is evident that the loss of life in this particular case would have been greater than it was three years ago had it not been for the protective measures that were taken as a result of the Bureau's warnings.

RIVER AND FLOOD SERVICE.

Great damage was done along the interior streams of central Kentucky in March, but with this exception there were no floods in the great rivers of the eastern and east-central portions of the country. At various times, however, floods occurred in the rivers of the Carolinas, Georgia, Alabama, Arkansas, Oklahoma, Kansas, Colorado, and California, the combined damage amounting to between $16,000,000 and $17,000,000. All of the flood stages were accurately forecast by the Weather Bureau. The losses reported were of an unavoidable character, while the value of the property saved as a result of advance warnings probably equaled the total amount of loss.

Two new river districts were established during the year, as follows:

1. Bismarck, N. Dak., with territory comprising that portion of the watershed of the Missouri River from Bismarck westward. This territory was formerly a part of the Sioux City, Iowa, district.

2. Wichita, Kans., with territory comprising that portion of the watershed of the Arkansas River from Wichita to the Kansas-Colorado line. This territory was formerly a part of the Fort Smith, Ark., district.

The study of the Ohio River has been continued during the year and the scheme of forecasting completed for that portion between Pittsburg and Louisville. The work on the lower river will probably be finished during the coming year and the scheme for the Mississippi begun.

Plans for the coming year will doubtless include increased observations in existing river districts and a cooperation with lines of work connected with the irrigation projects on the western streams.

MARINE WORK.

The Marine Division has continued its collection of observations from the oceans for use in the preparation of data for meteorological charts of the oceans. Data relative to fog prevalence along the northern route to Europe and on the banks of Newfoundland have also been prepared in the interest of navigation. This division has supervision of the wireless telegraph service conducted at points on the Pacific coast for obtaining and utilizing weather reports from the sea in the forecast work of the Bureau. It also has charge of the vessel-reporting service carried on by the Bureau for the benefit of maritime exchanges and the masters and owners of vessels.

WATER RESOURCES.

The study of snowfall conditions in the mountain regions has been furthered by the establishment of a large number of observing stations in the more inaccessible sections of the country. The Weather Bureau has cooperated in this work with other Government bureaus engaged in irrigation and reclamation projects. As the plans progress it is expected to complete a set of observations that will greatly increase the knowledge of the annual snowfall in those remote districts from which the western streams receive their water supply.

EVAPORATION STUDIES.

This work has continued at the evaporation stations on the Salton Sea and has been taken up at several of the western Reclamation Service projects and at stations of the water resources branch of the

Geological Survey in the territory east of the Mississippi. Information regarding evaporation is needed in connection with the engineering and reclamation work now being carried on in the arid districts of the West, and present arrangements provide for simultaneous measurements of evaporation in every type of climate.

NEW APPARATUS.

The demands for new apparatus have been met through the installation of booths for instrument display in the open squares of the larger cities; the construction of automatically recording river gauges; the perfecting of improved apparatus for measuring snowfall and for the registration of temperature and solar radiation, and instruments for the observation and study of evaporation. Some of these instruments have been perfected, while others are still in process of construction. The evaporation apparatus and snowfall collectors will be of special value in connection with the studies being made in the semiarid regions of the West and in obtaining reliable snowfall records in the high mountain regions of the country.

METEOROLOGICAL RECORDS.

A radical change in the methods of publication was introduced with the current year, the change having in view the presentation of meteorological data according to the natural divisions of the country, instead of by States as formerly. It is believed that the new method of publication will make the information more readily available than heretofore for the special use of any of the various enterprises or lines of development now being carried on throughout the country. The Monthly Weather Review has also been altered in character; in its new form it contains the tables of data prepared according to the new plan of publication and also a discussion of these data from the standpoint of the natural resources of the United States and their conservation, and it represents the mutual interests of the various branches of the Federal Government that are engaged in investigations of the country's resources.

BUREAU OF ANIMAL INDUSTRY.

The work of the Bureau of Animal Industry not only deals with the live-stock industry, but has an important bearing on the public health through the meat inspection, through efforts for the improvement of the milk supply, and through the investigation, prevention, and eradication of diseases which affect man as well as the lower animals. Indeed, the animal and the human phases of the Bureau's work are so closely related and interwoven that they could not be separated without detriment to the efficiency of the service and without causing considerable duplication of work and expenditure.

In studying and eradicating animal diseases the work is often of indirect benefit to human health. In the meat inspection the knowledge required is primarily that of animal diseases and comparative pathology rather than of human medicine. While the wholesomeness of dairy products is of great importance to human health, the methods by which wholesome and sanitary dairy products are to be obtained are mainly questions for the veterinarian, the dairy bacteriologist, and the scientific dairyman.

There is great advantage and decided economy in having a specially trained and well-equipped central organization such as the Bureau of Animal Industry. Members of the force can be and are shifted as the needs of the service require. For instance, veterinarians engaged in field work in the eradication of animal diseases in the summer may be assigned to meat inspection in the winter, when the most slaughtering is done. The great value to the country of such an organization, with its staff of scientists and veterinarians, was strongly demonstrated during the recent outbreak of foot-and-mouth disease. Experienced and trained veterinarians to the number of 159 were temporarily withdrawn from the meat inspection and other branches of the service and assigned to the eradication of foot-and-mouth disease. New men were put in their places, and as these new men were assigned to work with and under experienced men the efficiency of the regular work was not impaired by the change. In this way not a day was lost in beginning effective work against foot-and-mouth disease after the discovery of the outbreak. Had any time been lost in getting together a force of competent men the contagion would have spread widely in the meantime and would undoubtedly have reached the great stock-growing regions of the West, where it would have caused tremendous damage and loss and where its eradication would have been exceedingly difficult and expensive, if not impossible. If the meat-inspection force had been under separate management it would have been impracticable to transfer the necessary men so promptly, even if this could have been arranged at all; and furthermore, men working on meat inspection alone would have lacked the varied experience and usefulness possessed by men trained in the broader work of the Bureau as at present organized.

Erroneous and misleading statements have been published to the effect that large sums are spent by the Department of Agriculture for the health of animals while practically nothing is spent for the protection of human health. It should be remembered that the Department's work through the Bureau of Animal Industry, besides including the study, prevention, and stamping out of animal diseases, accomplishes much for the health of the people, especially through the meat inspection and the work for purer milk.

MEAT INSPECTION.

The meat inspection has continued to grow in magnitude until it has almost reached the maximum that can be carried on under the standing appropriation of $3,000,000 made by Congress, the expenditure for this work during the fiscal year having amounted to $2,884,000, an increase of about $165,000 over the previous year. The inspection was conducted during the past fiscal year at 876 establishments located in 240 cities and towns, an increase of 89 establishments and 29 cities and towns.

There were inspected before slaughter 56,545,737 animals, consisting of 7,588,144 cattle, 2,063,579 calves, 35,831,552 hogs, 10,992,579 sheep, and 69,883 goats. The animals inspected at and after slaughter numbered 55,672,075, of which 7,325,337 were cattle, 2,046,711 calves, 35,427,931 hogs, 10,802,903 sheep, and 69,193 goats. Of these, 141,085 carcasses and 899,628 parts of carcasses were condemned. Tuberculosis continues to be the cause of condemnation of the greater portion of the condemned cattle and hog carcasses, and over 99 per cent of the condemnations of parts of hog carcasses were due to this disease.

Nearly 7,000,000,000 pounds of meat food products were prepared and processed under the supervision of the government inspectors, and there were condemned on reinspection 24,679,754 pounds of meat products which had become sour, tainted, putrid, unclean, or, in the case of fats, rancid since inspection at slaughter. These latter condemnations show a decrease of 43 per cent from those of the previous year, indicating that the close supervision and strict sanitary requirements of the Department under the authority given by the new meat-inspection law have brought about great improvement in sanitary conditions and in the methods of handling meat products.

In justice alike to the public and to the members of the force, the Department makes it a practice to investigate thoroughly all charges that are sufficiently grave and specific to merit such attention. While absolute infallibility and perfection are not claimed and can not be expected, it is gratifying to be able to state that searching investigations at different times and places have revealed nothing that should impair public confidence in the service, but on the contrary have shown that with few very rare exceptions the members of the force are honest, competent, hard-working, and deserving of praise for their good work.

The Department maintains a constant and close surveillance over all its work of meat inspection. No less than seven traveling inspectors go about among the various stations, the times of their visits being unknown beforehand to the local employees. It would be exceedingly difficult for corruption or inefficiency to reach serious proportions or to exist very long without detection.

INSPECTION OF EXPORT ANIMALS.

The outbreak of foot-and-mouth disease caused a considerable reduction in exports of cattle and sheep. The Bureau of Animal Industry made during the fiscal year 397,925 inspections, including reinspections of 227,255 animals for export from the United States, besides inspecting 50,943 Canadian animals in transit through the United States for export. There were inspected on arrival at British ports, by Bureau inspectors stationed there, 259,297 animals from the United States and Canada. During the year 473 inspections of vessels carrying live stock were made in order to see that the fittings, equipment, ventilation, feed, water, attendants, etc., conformed to the regulations.

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

In order to prevent the introduction of contagious diseases of live stock the Bureau makes a rigid inspection of all imported animals at ports of entry, and a quarantine is imposed upon animals from all parts of the world except North America. During the fiscal year 237,804 imported animals were inspected, 4,760 of which were also quarantined.

CONTROL AND ERADICATION OF CONTAGIOUS DISEASES OF LIVE STOCK.

FOOT-AND-MOUTH DISEASE.

The outbreak of contagious foot-and-mouth disease, referred to in my previous report, was stamped out after a vigorous campaign by this Department in cooperation with the authorities of the affected States. The disease was discovered in Pennsylvania early in November, 1908, and the territory affected comprised fifteen counties in Pennsylvania, five counties in New York, two counties in Michigan, and one county in Maryland. The plan of eradication followed was similar to that successfully employed six years previously in the New England outbreak, namely, to enforce a strict quarantine, to discover all infected animals and localities, and to slaughter and bury all diseased and exposed animals and disinfect the premises occupied by them. The condemned animals were appraised and the owners were paid the full appraised value, two-thirds by the Department and one-third by the State. The expenses of burial, disinfection, etc., were shared in the same way.

The total number of animals slaughtered was 3,636, and their total appraised value was $90,033.18. The figures by States are as follows: In Pennsylvania, 1,232 cattle, 1,000 hogs, 52 sheep, 4 goats; a total of 2,288 animals, valued at $58,667.22, on 101 premises. In New York, 520 cattle, 246 hogs, 214 sheep; a total of 980 animals, valued at $24,378.13, on 45 premises. In Michigan, 242 cattle, 23 hogs, 9 sheep, 3 goats; a total of 277 animals, valued at $5,359, on 9 premises. In Maryland, 31 cattle, 60 hogs; a total of 91 animals, valued at $1,628.83, on 2 premises.

The Bureau of Animal Industry had a force of 572 men, including 159 veterinarians, engaged in the work of inspection and eradication. In addition to the work of slaughter, burial, and disinfection, a vast amount of work was done in thoroughly canvassing the infected regions, going from farm to farm and inspecting all animals, and in investigating rumors of disease so as to detect all cases. The number of visits made by the Bureau's inspectors was 108,683, and the total number of animals inspected, including reinspections, was more than a million and a half. Besides the infected States the inspectors visited points in Ohio, Indiana, Kentucky, West Virginia, Virginia, New Jersey, Delaware, and Connecticut in tracing rumors.

The federal quarantine, which was first placed upon four counties in Pennsylvania, effective November 13, 1908, was extended from time to time as additional territory was found to be infected. With the progress of eradication the quarantine was modified and partly released from time to time, as conditions warranted, and was entirely removed April 24, 1909.

The amount expended by the Department of Agriculture in eradicating the disease was barely kept within the special appropriations, aggregating $300,000, made by Congress for that purpose. Fortunately the disease was confined to practically the territory infected at the time of its discovery and was prevented from spreading to other sections. If it had persisted longer or spread farther, it would have been necessary to call upon Congress for additional funds.

On tracing the origin of the disease, which was at first a matter of mystery, it was soon found that the cattle which carried it into Pennsylvania came through the Buffalo stock yards, and from Buffalo suspicion pointed to Michigan. I visited Buffalo and Detroit, in company with the Chief of the Bureau of Animal Industry, in order to give personal attention to the situation. It was believed from the first that the contagion must have come from abroad, yet in view of the Department's strict quarantine on imported live stock it was considered improbable that it could have been brought in with animals, and other means of entrance were looked for. When inspectors of the Bureau of Animal Industry traced the disease to certain calves that had been used by a Detroit firm for the propagation of smallpox vaccine it was regarded as very probable that the vaccine was contaminated with the virus of foot-and-mouth disease and that the outbreak was due to this cause. I therefore directed that a careful scientific investigation be made to determine this point, and the work was intrusted to Dr. John R. Mohler, of the Bureau of Animal Industry, and Dr. Milton J. Rosenau, of the Public Health and Marine-Hospital Service, that Service having been invited to join in the investigation because it was charged by law with the supervision of biological products used in human medicine.

These investigators by a noteworthy piece of scientific work demonstrated that the smallpox vaccine virus of the Detroit firm was in fact contaminated with foot-and-mouth disease, and, further, that the vaccine of a Pennsylvania firm, from which the particular strain of vaccine in question was obtained by the Detroit firm, was likewise contaminated. While it is not positively known just how long the contamination had existed at the Pennsylvania establishment, it seems probable that it was introduced with vaccine virus imported from Japan in 1902, and that it was the cause of the New England outbreak of that year.

The introduction of the contagion through contaminated vaccine shows the importance of a congressional enactment giving to the Secretary of Agriculture power to control the importation of biological products intended for the treatment of animals, and to supervise the preparation of such products for interstate commerce, in the same manner that such products for use in human medicine are already under the control of the Public Health and Marine-Hospital Service. With the progress of medical and veterinary science there is an increasing traffic in vaccines, serums, antitoxins, etc., and there is great danger that without proper control there may be introduced with these remedies the contagion of some disease that would cause havoc among our live stock.

TICK ERADICATION.

Continued progress has been made in exterminating the ticks that spread the infection of Texas fever of cattle in the South. During the fiscal year areas aggregating 13,544 square miles were released from quarantine because of having been freed from the ticks, these areas being located in Virginia, North Carolina, Tennessee, Arkansas, Oklahoma, and California. Since the beginning of the work in 1906 there have been released 71,336 square miles. In connection with this work during the past fiscal year the inspectors of the Bureau of Animal Industry made over 3,000,000 inspections of cattle. The work of tick eradication is being carried on in cooperation with state authorities, and it is the Department's policy to operate only in States and localities where official and public sentiment are favorable. The amount expended by the Department for this work in any State is dependent upon the amount that the state or local authorities are prepared to expend.

The tremendous benefits to be derived from this work become more evident as it progresses. In sections that have been freed from the ticks the farmers are obtaining higher prices for their cattle than can be realized for cattle from below the quarantine line, and they are also raising more and better cattle. At the leading markets to which southern cattle are shipped there is a difference ranging from $2.25 to $5 a head between the prices paid for tick-infested cattle and for cattle of similar grades from the tick-free areas, and more than 1,000,000 southern cattle from the quarantined area are sold annually at these markets, besides animals marketed locally in the South. Taking $3 a head as a conservative average difference, it appears that there is an annual loss of over $3,000,000 on southern cattle shipped to northern markets, not taking into account the losses from the lighter weight and poorer condition of the tick-infested animals or the difference in price on animals marketed in the South. This is only one item in a heavy account of losses chargeable to the tick and which can be entirely overcome by exterminating the pest. The enormous economic value of this work and the possibility of its success are beyond question. It is only a matter of adequate appropriations by the state and federal governments.

SCABIES OF SHEEP AND CATTLE.

The work of eradicating the diseases known as scabies of sheep and cattle, which has been in progress for several years in cooperation with the authorities of a number of Western States, has been continued with good results and the infected territory has been still further reduced. During the fiscal year the States of Kansas, Nebraska, Montana, North Dakota, and South Dakota were released from the quarantine on account of sheep scab, and areas aggregating over 60,000 square miles in North Dakota, Colorado, Oklahoma, Kansas, and New Mexico were released from the quarantine for scabies in cattle. Employees of the Bureau of Animal Industry made 59,762,512 inspections of sheep and 17,656,934 inspections of cattle, and supervised 15,597,823 dippings of sheep and 1,559,477 dippings of cattle. Since the close of the fiscal year it has been found necessary to place a federal quarantine on the State of Kentucky because of the increasing prevalence of sheep scab. Heretofore the quarantine for this disease has been confined to the West, and this is the first time that it has been considered necessary to impose a quarantine east of the Mississippi River.

TUBERCULOSIS.

Under the provision of the appropriation act for the past fiscal year "to enable the Secretary of Agriculture to investigate the prevalence and extent of tuberculosis among dairy cattle in the United States," the tuberculin test was applied to numbers of cattle in several parts of the country by arrangement with state and local authorities. Cattle were tested for interstate shipment to States requiring the tuberculin test as a prerequisite to the admission of dairy and breeding cattle, and assistance was also given to city authorities in testing cows which furnished milk to certain cities. In all, 8,809 cattle were tested, of which 744, or 8.45 per cent, reacted as tuberculous. The proportion of tuberculous cows among those tested which supplied milk to cities was about 13 per cent.

The Bureau of Animal Industry has also endeavored to assist state live-stock sanitary officers in locating centers of tuberculous infection by reporting to these authorities the names and addresses of owners and feeders of cattle and hogs found tuberculous in the meat inspection, and such reports were made to authorities of twenty-eight States during the fiscal year.

Both of these lines of work should be and will be continued, so as to collect information as to the condition of a larger number of animals in a greater number of localities; but it is evident that tuberculosis prevails to an alarming degree, especially among milk cows, and that more aggressive measures should be taken by public authorities to check and stamp out the disease. To undertake the eradication of tuberculosis from the entire country would be a tremendous task, which would require the expenditure of an immense sum of money. As a preliminary measure it would probably be better to make a demonstration of what can be done in a small way by confining the work to certain localities. It might be well to establish small quarantined areas where the disease is found to be unusually prevalent and to allow cattle and hogs to be shipped out for slaughter only when tagged for identification. Animals found diseased when slaughtered should then be reported back and steps taken to control or eradicate the disease on the particular farms where they originated. Cattle shipped from such quarantined areas for purposes other than slaughter should be required first to pass the tuberculin test. By some such method the disease could doubtless be gradually reduced and finally stamped out in the areas referred to, and the work could be gradually extended.

HOG CHOLERA.

The Department has continued its efforts to interest state authorities in undertaking the preparation of serum according to the method of Dr. M. Dorset, of the Bureau of Animal Industry, for the prevention of hog cholera, as the manufacture of the serum for the use of hog raisers throughout the country is too great a task for the Department to assume. During the year representatives of fifteen States at the invitation of the Department visited the experimental farm of the Bureau near Ames, Iowa, where they conferred with representatives of the Bureau, and had opportunity to observe and study the methods used. As a result of these conferences and others held during the preceding year at least twenty States have taken up the preparation of the serum to a greater or less extent. The plan is for each State to make provision for the manufacture of the serum for distribution among its citizens on such terms as may be considered proper. Considerable serum has been prepared by state representatives, and 25,000 hogs have been treated with serum from these sources. The results have been so satisfactory that it is expected that the state work will be enlarged where it has already been undertaken and inaugurated in other States where hog raising is an important industry.

RABIES.

Judging by the increasing number of animals sent to the Bureau in order that diagnoses may be made as to whether or not they are affected with rabies, this dangerous disease appears to persist and even to have increased in prevalence during the year, especially in the vicinity of Washington, D. C. Out of 153 animals suspected of being affected and sent in for examination, 104 were found to be rabid, and these had bitten no less than 48 persons, besides a much larger number of animals. As the persons bitten were promptly notified of the diagnosis so that they might take preventive treatment, no deaths of persons are known to have resulted, but considerable anxiety and expense have nevertheless been caused to them and their families. Experience has shown that the strict enforcement of muzzling all dogs for a sufficient period is the most effective means of stamping out the disease, and no improvement may be expected until proper measures are vigorously applied.

NECROBACILLOSIS IN SHEEP.

During the year lip-and-leg ulceration and other forms of an infectious disease of sheep known as necrobacillosis have become quite prevalent in Wyoming and Montana, and the Bureau of Animal Industry has investigated the nature and extent of the disease with a view to combating it. This disease has existed in a mild form for many years and only recently has assumed a virulent form and seriously threatened the sheep industry. Certain portions of Wyoming were found to be so badly infected that soon after the close of the fiscal year they were placed under federal quarantine and shipments of sheep therefrom are permitted only under certain restrictions. Treatment is effective if carefully and thoroughly applied, and it is hoped that by the combined means of treatment and quarantine the infection may be checked and stamped out without spreading to other parts of the country.

BLACKLEG VACCINE, TUBERCULIN, AND MALLEIN.

The preparation and distribution of vaccine for the prevention of blackleg in young cattle, which has been carried on by the Bureau for several years with the result of greatly reducing the losses from this disease, have been continued, about 1,150,000 doses having been sent out to stock owners free of charge during the year.

There were supplied to official veterinarians and health officers during the year over 250,000 doses of tuberculin for the diagnosis of tuberculosis in cattle, and more than 55,000 doses of mallein for the diagnosis of glanders in horses.

TUBERCULOSIS INVESTIGATIONS.

The scientists of the Bureau of Animal Industry have continued their studies of tuberculosis. An investigation of this disease as it simultaneously affected hogs and poultry on an Oregon ranch demonstrated that the transmission of tuberculosis from fowls to swine readily occurs. During the year an article by an American investigator pronouncing tuberculosis in all its forms to be a bacteriemia—indicating that the disease was constantly associated with the presence of numerous tubercle bacilli in the blood—led the Bureau to carry out a series of experiments on this point, which had an important bearing on the meat-inspection regulations; and as a result of these experiments it was shown that while in some forms of the disease the bacilli may in rare instances be present in the blood for short periods of time, tuberculosis, at least in animals, is not characterized by the condition referred to and can not properly be termed a bacteriemia. Experiments made by the Bureau during the year with reference to the sources from which hogs contract tuberculosis indicate that infection occurs much more readily from allowing hogs to feed on the feces of tuberculous cattle than from exposing them to tuberculous hogs or feeding them the milk of tuberculous cows, although the latter is also a common mode of infection. Tests of the duration of life of tubercle bacilli in butter and cheese are still in progress, as are also various investigations in the immunization of cattle against tuberculosis.

INVESTIGATION OF OTHER DISEASES AND CONDITIONS.

The work on infectious anemia or swamp fever of horses, epizootic lymphangitis of horses, and chronic bacterial dysentery of cattle have been continued, and publications giving information as to these diseases have been issued or prepared. The work of the past year on infectious anemia has been mainly directed to developing a method of producing artificial immunity, and the results so far obtained give promise of success.

Experiments with a view to ridding sheep of roundworms have been continued, and it has been shown that the degree of infection in lambs can be reduced by changing the flock at intervals to fresh pasture, and that by keeping lambs and ewes separated under certain conditions the lambs can be entirely protected from infection. This work is of considerable practical value to sheep raisers in regions where losses from parasitic infection are heavy.

Investigations have also been made or are in progress concerning anthrax, infectious ophthalmia in cattle, pseudo-leukemia in hogs, injury to live stock by feeding cotton-seed meal, milk sickness in Tennessee, "sandburn" in Texas, and other diseases and conditions, including diseases of poultry and other birds.

TESTS OF SERUMS, ETC.

Under authority of Congress tests have been made of tuberculin, serums, and analogous products sold for the detection, prevention, treatment, or cure of diseases of domestic animals. Two imported preparations advertised and labeled, respectively, as a serum and a vaccine against hog cholera were found to be ineffective for protecting hogs against that disease. A domestic preparation widely advertised as an "antiabortion serum" was found not to be a serum at all, but to consist of a weak solution of carbolic acid. The tuberculins tested during the year were all found to be satisfactory. Several so-called "rat viruses" were also tested, but none were found to contain germs that were reliable agents for killing rats or spreading disease among them.

ANIMAL HUSBANDRY.

BREEDING AND FEEDING.

The Bureau's investigations in animal breeding and feeding have progressed satisfactorily. Carriage horses are being bred in Colorado, Morgan horses in Vermont, Shire and Clydesdale horses in Iowa, range sheep in Wyoming, and milking Shorthorn and Holstein cattle in Minnesota. The experiments in animal nutrition at State College, Pa., and those in beef production in the South have been continued along the same lines as during the previous year and are yielding satisfactory results. In the breeding experiments at the Bureau's experiment station at Bethesda, Md., six zebra-ass hybrids were foaled during the year, three of which died, while the remaining three are vigorous and promising. Extensive experiments involving the use of nearly 4,000 small mammals, to determine certain points regarding inbreeding, heredity, etc., are under way at the station.

CLASSIFICATION FOR AMERICAN CARRIAGE HORSES.

The classification for American carriage horses proposed by the Department, in conjunction with certain breeders' associations, was used at twelve state fairs in 1908, and resulted in some good exhibits. Fourteen fairs of state or national importance offered the classification in 1909. This classification is expected to be of great value to farmers and horse breeders in the development and production of a good type of carriage horses.

POULTRY AND EGG INVESTIGATIONS.

Besides the cooperative experiments in poultry breeding and feeding at the Maine Agricultural Experiment Station, the Bureau has in progress some independent investigations, which are nearing completion, for the comparison of different methods of feeding poultry.

During the year a study was made of the conditions surrounding the production and marketing of eggs, and a report was published pointing out the heavy losses and the means by which they might be overcome. A cold-storage evaporimeter, for measuring and regulating moisture in storage rooms, was devised by a member of the Bureau staff and has been patented by the Department so that it may be used by the public in this country free of royalty.

WORK RELATING TO THE DAIRY INDUSTRY.

SOUTHERN DAIRYING.

The educational work for the development and improvement of the dairy industry in the South has been continued along the same lines as in the previous fiscal year. Records have been kept of 73 herds containing 1,642 cows, enabling the owners to know just what results were being obtained from each cow and to eliminate unprofitable animals. Many of these owners have been induced to use purebred bulls for the improvement of their herds. Assistance has been given in the improvement of the milk supplies of 20 southern cities. Plans have been furnished and advice given for the construction of barns, stables, dairy houses, silos, etc. Agents of the Bureau have spoken at numerous meetings, have given instruction in schools, and have given advice and assistance to individual dairymen and farmers. The organization of dairy associations has been encouraged. The policy is to work in cooperation with state authorities and through institutions and associations so far as possible, and to turn the work over to these bodies gradually as they are prepared to take it up and carry it on. Several States have provided men and appropriations for such work. The work so far done is proving of great practical benefit. The South has great possibilities for a prosperous dairy industry, but there is need of development of resources and improvement in quality of animals and in methods.

COW-TEST ASSOCIATIONS.

Assistance has been given to state officials in organizing and conducting associations for the purpose of keeping records of dairy herds and cooperating for the mutual advantage and improvement of the members. There are now 27 of these associations organized, with 741 members, owning 11,686 cows, in 9 States.

DAIRY PRODUCTS INVESTIGATIONS.

Investigations and experiments have been carried on to determine various problems with regard to the manufacture of butter and cheese, and the bacteriology and composition of milk. The study of factors influencing undesirable changes in storage butter has yielded important practical results. It has been found that acid in cream causes great changes in the flavor of such butter, and that the troublesome "fishy flavor" occurs only in highly acid butter and sometimes only when it has been overworked. It has been determined that butter with excellent keeping quality can be made of pasteurized sweet cream without the use of a "starter," and this seems to be a remedy for some of the conditions that have caused loss to the butter trade.

Work on the Cheddar, Swiss, Camembert, and Roquefort types of cheese has been continued, and information of practical value to the cheese industry is being developed. A special study has been made of the difficulties encountered in the manufacture of the Camembert type of cheese in the United States. It appears that climatic conditions are unfavorable during the greater part of the year in most of the regions where factories have been located, but that this disadvantage can be overcome by constructing factories in such a manner as to provide proper control of temperature, humidity, and ventilation.

A study of commercially pasteurized milk has shown that in this process the lactic-acid bacteria are not entirely destroyed, and that they continue to check the development of harmful bacteria.

DAIRY MANUFACTURES.

The inspection of butter as received at three of the principal markets has been continued with benefit to the trade. The inspection is made at the request of the dealer or producer, and the defects in the butter are pointed out in a letter sent to the producer with suggestions for overcoming them.

The Bureau has rendered assistance to 159 creameries with a view to remedying difficulties and losses, and it is estimated that in consequence about $250,000 was saved to them during the past year.

IMPROVEMENT OF MILK SUPPLIES.

The Bureau of Animal Industry has carried on an important line of work for the improvement of the milk supplies of various cities. Representatives have been sent on request of local authorities to cooperate with them. Public meetings are often arranged for producers, consumers, physicians, and others, at which addresses are made and the subject of milk improvement is discussed, and sometimes there are competitive exhibitions of milk and cream. The score-card system of inspection is an effective means of improving the sanitary condition of dairies, and the Bureau recommends the use of this system and gives assistance in introducing and applying it. During the year the score-card system was adopted in 64 cities, making the total number now using it 125. Bureau representatives visited 315 dairy farms, located in 18 States, during the year, for the purpose of assisting local inspectors in the use of the score card, and the average score on these farms was 46.42 points on a scale of 100. Reports received on 29,970 dairies show an average score of 52. As a rule the scores are entirely too low, but marked improvement usually follows the inauguration of dairy inspection by the score-card system.

RENOVATED-BUTTER INSPECTION.

The Department is charged by law with the supervision of factories producing renovated or process butter and with the inspection of the materials used and the product turned out. Inspection was carried on at 43 factories during the year, and the product amounted to 47,432,276 pounds, a slight decrease as compared with the previous year.

OTHER DAIRY WORK.

A very practical and helpful feature of the Bureau's work is the designing of various kinds of buildings and the furnishing of drawings and specifications for their construction. During the past fiscal year 2,086 blueprints were sent out.

Experiments in stable ventilation have been in progress for the past two years, to test the efficiency of methods already in use and to improve upon them if possible. The results indicate that certain hitherto accepted principles of ventilation are wrong, and it is believed that this work will be the means of improvement.

BUREAU OF PLANT INDUSTRY.

A rapidly growing interest is being shown in this country in what may be termed agricultural readjustment. The shifting and changing of economic conditions due to world-wide influences and the almost complete reversion of old and established agricultural practices and methods due to purely local causes all tend to make the study of crop production and crop adaptation more and more complicated each year.

WORK FOR THE DRY-LAND FARMER.

A striking example of the trend of agricultural development and effort at readjustment is found in the widespread demand for help coming from all that vast territory west of the one hundredth meridian and popularly spoken of as the dry-farming area or the Great Plains region. The nation, the States, and private interests are doing much to attract settlers to this territory, especially to the irrigated portions of it, and in consequence the demand for knowledge on the part of settlers is greater at present than can be supplied.

With a view to aiding those who are seeking to make homes in this region, a number of lines of work have been inaugurated, the more important of which may be briefly reviewed.

Experiments to determine basic facts.—To secure knowledge on certain fundamental subjects, investigations have been in progress in the Great Plains area under the supervision of the Office of Dry-Land Agriculture since the spring of 1906. Experimental work is now under way at thirteen stations, located as follows: Judith Basin and Huntley, Mont.; Williston, Dickinson, and Edgeley, N. Dak.; Bellefourche, S. Dak.; North Platte and Scottsbluff, Nebr.; Akron, Colo.; Hays and Garden City, Kans.; and Amarillo and Dalhart, Tex. The work at all these stations is identical. Cropping systems, including continuous cropping with a single crop (such as wheat, corn, oats, or barley), alternate cropping and summer tillage with these same crops, and many crop rotations of two, three, four, five, and six years have been established. Crop sequence, green manuring with both legumes and grasses, time of plowing, depth of plowing, effects of tillage both before and after seeding, and, in short, practically all the various combinations of crop sequence and tillage methods suggested or practiced in this region for the conservation of moisture are being carefully studied.

Work on the reclamation projects.—Closely affiliated with the foregoing work is that undertaken in cooperation with the Reclamation Service and at the request of the officers of that Service. The Reclamation Service is proceeding with the development of its irrigation projects, and as these are being completed the necessity for advice and assistance along agricultural lines becomes more and more evident. The cooperation undertaken by the Bureau of Plant Industry involves close relations with the experiment stations in the States in which the projects are located. The new regions have peculiar and often unusual agricultural conditions and present problems that are complicated on account of the special crops grown and the limited number of workers at hand.

Field stations have been established on the projects proper. Through these field stations the investigators of the Department are able to be of direct assistance to new settlers by putting the results of their investigations into practice where such results can be seen and appreciated. The work therefore partakes in part of experiments, in part of tests of various crops, and to a certain extent of direct demonstrations. The demonstration work can not as yet be very rapidly pushed, owing to lack of knowledge regarding the character of the crops that can be grown and how they should be grown. This work is now in progress at Yuma, Ariz.; Fallon, Nev.; Klamath and Umatilla, Oreg.; Huntley, Mont.; and Bellefourche, S. Dak.

FORAGE CROPS FOR THE DRY SECTIONS.—The forage-crop problems for the dry sections fall within four principal lines: (1) A thorough testing of the most promising crops at hand; (2) new methods of culture for alfalfa and perennial grasses, so that they can be grown with less rainfall; (3) the search for new drought and cold-resistant forage crops; and (4) the breeding of new crops for all this section.

In the testing of promising forage crops very promising results have been secured in the northern half of the Great Plains region with Canadian field peas. It is necessary to grow this crop alone, as the moisture is not sufficient to support the plants with a mixture of small grains. This crop has succeeded well on all the dry-land farms as far south as Amarillo, Tex.

Another important crop for the dry section is Siberian millet, introduced by the Department in 1899. This plant is proving valuable, on account of its great resistance to drought and its short season. Elaborate tests are being made with the sorghums as a dry-land crop. These plants are found to have great resistance to drought, and the quantity and quality of roughage produced per acre and the sureness of the crop make it of great importance, especially where dependence is placed on stock farming. A special feature is being made of alfalfa culture for this entire section. When broadcasted even the most drought-resistant varieties of alfalfa require about 15 inches of rainfall in Dakota, 18 inches in Nebraska, and 20 inches in Texas. When cultivated in rows, however, the crop succeeds under more arid conditions.

The cold and drought resistant alfalfas which were referred to in my last report as having been obtained in Siberia are still under test, and it is hoped that out of them, by breeding and otherwise, there may be secured some strains of great value to the northwestern sections of the United States. Cultural methods as affecting the growth of forage crops in this dry region have received considerable attention. The methods of growing alfalfa in rows have already been referred to. Similar methods have been applied to growing certain grasses, with good results. In portions of the drier regions of Texas very promising results have been secured from alfalfa growing, using the crop as a pasture for hogs. It has been found that where the alfalfa is pastured growth is more abundant, owing doubtless to the much smaller evaporation of water. The evidence at hand seems to indicate that when alfalfa is pastured in these drier regions it far outyields the crop grown in the ordinary way. Breeding to secure drought and cold resistant crops for this region is being pushed vigorously. Promising results in breeding alfalfa, millet, and certain types of sorghums have already been secured.

Durum wheat.—The annual production of durum wheat at present, though difficult to determine before taking a census, appears to be at least 50 million bushels, and probably comes nearer to 60 million. The important fact, however, is that a rough estimate shows that nearly two-thirds of this production is in districts so dry ordinarily that other wheats can not be successfully grown, thus having made it possible during the past year to add materially to our wheat crop during the time of scarcity and high prices. Recently two additional interesting facts have developed: (1) The great interest taken by several of the largest mills in the country in the manufacture of patent flour from durum wheat. One of these, a Minneapolis firm, now employs a mill of high capacity exclusively on durum wheat. (2) The rapid increase in the use by foreign countries of our export durum wheat for bread flour. The export now averages considerably over 20 million bushels per annum, of which nearly or quite one-half goes to central and northern Europe, where it is used chiefly for bread.

Recently there has been an extension of the durum-wheat area into the western portions of the Great Plains and Intermountain districts. A number of new mills have been added to the list of those that grind the wheat, some of which are using it exclusively. Examinations of a number of samples received from different parts of the country show that recent reports of the deterioration of the wheat are unfounded, but have been caused by the fact that much of the grain shipped east was produced in humid areas not adapted to durum wheat and often mixed with other lots of better quality. American millers need to become more familiar with the quality required in wheat of this class.

Dry-land cereals.—Durum wheat has now made its place as a semidry-land crop in the middle Great Plains region and is being rapidly extended into the intermountain dry-land districts. During the past year the work with dry-land cereals has been extended so that at the present time a comprehensive series of experiments is under way at Amarillo and Dalhart, Tex.; Akron, Colo.; Bellefourche and Highmore, S. Dak.; Williston and Dickinson, N. Dak.; Judith Basin, Mont.; Nephi, Utah; and Moro, Oreg. The experimental work at each station is under the charge of men specially qualified along the lines of grain improvement and familiar with the territory in which the station is located. Although these experiments in their present form have been running but three years, and some of them for even a shorter period, the results thus far obtained in determining suitable varieties for each locality and the best dates and rates of seeding have proved of great assistance to old and new settlers in all the dry country. It is found that many of the farmers in this region who are planting cereals grow mixed varieties. This alone has probably as much to do with the low average yield per acre in the United States as any other factor. One of the objects of the work in question is to enable farmers to obtain pure seed of drought-resistant kinds of wheats adapted to particular districts.

A very important line of investigation and study has for its object the development of hardy winter varieties of grain crops. During the past year winter wheat was grown at Williston, N. Dak., for the first time, the yield being nearly 40 bushels per acre. At Bellefourche, S. Dak., winter wheat has matured two years in succession, and the yields have been highly satisfactory—usually from 20 to 50 per cent higher than those of the best spring varieties. Extensive tests in the matter of time of seeding winter wheats have brought out the fact more forcibly than ever that the earlier the seed is planted after the 15th of August, provided moisture conditions are at all favorable, the greater will be the percentage of survival.

Tree crops in dry farming.—In portions of the Old World, namely, northern Africa and the southern portion of Asia, where rainfall is deficient and agriculture has been practiced for thousands of years, great dependence is placed on tree crops. In these older countries the fact has been clearly brought out that deep or wide rooted trees are able to stand drought much better than shallow-rooted annual crops. It must be remembered that trees produce not only fruits and nuts, but also rough and concentrated stock food, oils, drugs, and various other industrial products. One of the most striking examples of dry-land agriculture which has yet been brought into prominence is olive growing in the semiarid regions of northern Africa. Here are found vast orchards of olive trees producing good crops year after year in regions where the rainfall often falls below 10 inches for years at a stretch. The system of culture in use there dates back to times of antiquity, when this part of Africa was controlled by the Romans.

With a view to introducing similar industries into the southwestern portion of this country, special studies have been conducted on the behavior of olive orchards in our own dry region where either through the failure of irrigation systems or for some other reason the trees have been deprived of their usual water supply. It has been found that the olive is remarkably resistant to drought, and while other fruit trees have died it has remained alive and borne crops of fruit under very trying conditions. Other important tree crops, such as the date, have been introduced, and studies are under way to determine what can be accomplished in securing trees which will produce stock food and other products useful to the farmer.

Studies of successful farms in dry regions.—By seeking out individuals who have been farming for a series of years and by gathering up their experiences, a good deal has been learned about the proportion of years in which there have been crop failures and about the crops which are most reliable under the semiarid conditions prevailing. This work is being carried on by the Office of Farm Management and is being correlated so far as practicable with other lines of study in the Department, especially the reconnaissance soil surveys being conducted by the Bureau of Soils.

From time to time farmers are found who have been living in the dry belt from ten to twenty years and have developed for themselves a successful system of agriculture. A study of these systems, together with the methods of handling the soil, will, it is believed, put the Department in possession of information which will be very useful to settlers, who must have some immediate information to help them in their work.

PROGRESS IN PLANT AND SEED INTRODUCTION.

The several new types of cold and drought resistant alfalfas and other forage crops secured by Prof. N. E. Hansen and referred to in my last report are under test at a number of stations.

Of the new things recently brought from China, our experts are watching with particular interest the behavior of the wild peach, employed extensively in China as a grafting stock in dry sections for the apricot, peach, and almond, and possibly for the cherry and plum. A stock of this kind would be very valuable in the southwestern dry portions of the country, and the remarkable growth of this peach in these regions has already attracted considerable attention.

Among other new introductions a seedless, nonastringent persimmon has made promising growth at various places throughout the South; also a large-fruited, dry-land Chinese date, which has been grafted successfully and seems to promise a new dried-fruit industry.

The Chinese pistache tree is another introduction which is not only promising as a shade tree for the Southwest, but is the hardiest of all pistaches and a promising stock for the important pistache nut of commerce. Large quantities of this pistache nut are now imported, and it is hoped eventually to have this industry taken care of in our own country.

So great has been the demand for new plants and new crops, especially for the cold northwestern portions of the country, that Mr. Frank N. Meyer, who returned a year ago from a three years' exploration trip through portions of Asia, has again been sent out with instructions to explore the dry semidesert areas which border on Chinese Turkestan, where there are forests of wild apples, pears, grapes, and other fruits. It is also planned to have Mr. Meyer get from the high altitude of the Tien Shan Mountains, in western China, types of early-ripening cereals. He will also secure certain leguminous forage crops adapted to cultivation and range improvement west of the Mississippi River.

An interesting development during the year has come in connection with the discovery by Mr. Aaron Aaronsohn, of Hefia, Palestine, of a very interesting wild wheat which grows on the stony mountain slopes and in the clefts of the rocks in the driest portion of Mount Hermon, in eastern Palestine. This wheat grows over a wide territory and is found at altitudes ranging from several hundred feet below sea level to 6,000 feet above, near the borders of snow fields. It is claimed that this wheat is the progenitor of our modern grain and may prove valuable as a stock for breeding strains of wheat adapted to cultivation in the dry, rocky soils of this country which at present are not considered fit for wheat culture. Arrangements have been made for securing this wheat for limited distribution to plant breeders throughout the country.

Legumes for the South.—Special attention has been given to securing leguminous crops for the Southern States in order to make possible greater opportunities in diversification. The farther south we proceed the more limited becomes the number of leguminous pasture or forage crops that can be grown. In Florida the velvet bean has long been one of the important annual legumes. Recent studies have resulted in finding no less than 14 related species, mostly from southern Asia. One of these, the Lyon bean, mentioned in a previous report, is being grown throughout Florida this year. It is decidedly more productive in pods and seeds than the ordinary velvet bean and seems certain to replace it to a large extent. Another species, the Yokohama bean from Japan, is the earliest sort yet found, maturing in about one hundred days, and is very prolific. This particular bean gives evidence of extending the range of this important crop.

New grasses for the South.—Among the new grasses recently obtained are two that give special promise of high value as hay grasses for the South. One of these is a grass sorghum from the Sudan closely resembling Johnson grass but completely devoid of the rootstocks which render that grass so obnoxious in many localities. Another, known as "Rhodes grass," is a native of Chile, but was first exploited in South Africa. Under Florida and Gulf coast conditions it thrives splendidly and permits of at least two cuttings in a season. The stems are fine and erect and the hay is of very high quality. This grass also gives promise of being valuable under irrigation in California, where extensive experiments with it are under way.

PROGRESS IN GRAIN INVESTIGATIONS.

Work with wheats and other small grains.—Special studies have been made with a view to improving the varieties of wheat and the methods of growing them in the principal grain-producing sections. It will not be practicable to give an estimate of the production of durum wheat until after the next census, but the total for the season of 1909 will probably be not less than 50 million bushels. So rapid has been the spread of this type of wheat that the care and attention necessary to maintain the highest standards in the quality of the grain have not been given. It is important that careful study shall be given to this matter, as the growing of the grain from impure seed or in localities where the climate is not favorable may act detrimentally to the crop as a whole.

Efforts are being made to extend the area of winter wheat, with promising results, the Kharkof variety being especially valuable in this connection.

The work on wheats in California, which has been in progress for five years, has resulted in the introduction and extensive growing of at least two varieties valuable for their yield and milling qualities.

Special work has been conducted in the development of other grains, notably varieties of winter oats and winter barley. The further use of these crops, especially in the South, is much to be desired, offering opportunities for the production of stock foods, through the grain, and also of winter pasture.

Considerable progress has been made in the work of improving American barleys adapted to the principal barley-growing sections of the Northwest. The factors of difference between high and low grade barleys have been studied in a new way—the internal structure of the grain itself—and discoveries have been made that furnish a more scientific basis for the cross-breeding and selection work which has been inaugurated.

During the year some systematic work on rice has been inaugurated, stations having been established in South Carolina, Louisiana, and California, and at one or two other points. In South Carolina the principal object of the work has been to secure varieties resistant to blight, or blast, and to obtain information regarding improved methods of culture. In Louisiana cooperative experiments have been inaugurated, having for their object the improvement of varieties in use, the introduction of new varieties, the improvement of cultural methods, etc. This work is being carried on jointly with the state experiment station and with the rice planters of Louisiana. In California some preliminary work has been inaugurated to determine the practicability of rice production in that State.

Work on corn.—During the past year the amount of interest shown throughout the United States in all phases of corn work was many times greater than in any previous season. The state experiment stations are now doing a great deal in the matter of encouraging better methods of growing and breeding corn, and the work inaugurated and carried on by the Department is in general line with these studies. It is not the purpose of the Department or the state stations to produce seed corn for farmers, but rather to determine and verify by a sufficient number of experiments and demonstrations the best methods for them to follow in the production of their seed. Particular attention has been given during the year to the breeding of corns for the South and in conducting tests and demonstrations for the purpose of determining the best methods of increasing yields.

Some interesting facts have been developed regarding the effect of different methods of conserving soil moisture on the yield of the grain. In the South, where summer droughts are likely to occur, the practice of planting corn in furrows from 4 to 6 inches below the level, which has been followed so long, has been found to be based upon sound principles, and by actual tests it has been shown that corn grown in this way has yielded from 4 to 5 bushels more per acre than where level cultivation was practiced. The presence of organic matter in the soil is another important factor in increasing the yields. In a number of instances heavy applications of fertilizers, as much as 1,400 pounds to the acre, have not increased the yield as much as a moderate amount of decaying vegetable matter turned under before the corn was planted.

PROBLEMS IN PLANT PATHOLOGY AND RELATED SUBJECTS.

As usual, the lines of work in the study of plant diseases and the means of controlling them have been many and varied. The investigational features have been advanced, but special stress has been laid upon field tests and demonstrations. During the year studies were conducted in the laboratories on several diseases of the white potato, diseases of sweet corn, crown-gall and other diseases of fruits, a serious bud-rot disease of the cocoanut, and on rice blast and other diseases of rice. During the year the usual efforts have been put forth to augment the pathological collections and to extend the inspection work necessary in connection with the importation, distribution, and handling of the large number of living plants and seeds brought in.

With a view to increasing the efficiency of the inspection work, a special greenhouse is being prepared for this purpose, and a plan is being perfected whereby, through the cooperation of other Bureaus in the Department, it is hoped the danger of introducing diseases or insects will be largely overcome. During the year inspections have been made of more than 150,000 plants sent out from the Department greenhouses and from the various offices of the Bureau.

The work on cotton diseases is now far advanced, and has for its object the distribution of improved disease-resistant varieties that have been developed. For a number of years the truck crops of the Atlantic coast have suffered from various diseases, the causes of which have proved quite obscure. It is found that a number of these troubles are due to malnutrition brought on by the improper use of chemical fertilizers. Investigations have shown the manner in which these diseases work, and suggestions have been secured which it is believed will make remedial treatment practicable.

Important advances have been made during the year in the treatment of fruit diseases. For twenty years the efforts of pathologists have been largely devoted to studies of diseases, comparatively little attention being paid to the improvement of the fungicides used. The main reliance has been upon various copper compounds. Recently these have been found to cause serious injury to certain fruits, and it was highly important that some effort be made to determine the cause of this injury, else spraying would have to be abandoned. Very decided progress has been made in this work by the discovery during the year of a number of what promise to be new and useful fungicides. Apples sprayed with these preparations show remarkably high coloration and freedom from all sorts of spots, rots, and other discolorations due to disease.

On the Pacific coast the important work on the eradication of pear-blight has been continued with encouraging results, special attention being given to this disease in portions of Oregon, where the Department received the very hearty cooperation of the fruit growers, especially those of the Rogue River Valley.

Among the other diseases studied during the year is that known as little-peach. Pecan scab has also been under investigation, experimental demonstrations being started in the southern part of California in the matter of spraying. This work has proved quite successful, and in connection with it other facts regarding the relation of varieties to scab have been obtained, which it is believed will be very useful to the pecan growers. Much work during the year has been conducted in the matter of demonstrations in fruit spraying, this important line of effort having been carried on in connection with various orchard fruits, grapes, and certain small fruits.

Studies in forest pathology.—Investigations of the diseases of forest, shade, and ornamental trees and shrubs are conducted in cooperation with the Forest Service. One of the most important diseases studied during the year is that affecting the chestnut. This trouble has spread south to Virginia, west at least to central Pennsylvania, and north to Rhode Island. Where the disease is already established nothing can save the trees. General quarantine methods conscientiously applied would probably check the advance of the malady into new localities. Experiments show conclusively that under orchard conditions the disease can be controlled by a definite pruning and cutting-out system.

Another disease of forest trees known as the white-pine blight has been under investigation during the year. Owners of pine may be assured that there is little to fear from this disease, and there is no reason why reforestation with white pine should be further delayed.

Another very serious disease of white pine was called to the attention of the Department during the year and has been made the subject of study. This is caused by one of the rusts and was introduced from Europe into Vermont, New Hampshire, Massachusetts, Connecticut, New York, and Pennsylvania. In many parts of Europe the rust prevents the growing of white pine, and there is no reason for assuming that it would be less serious in America if once established. Efforts have been made to keep the disease from again being imported and to call the attention of the growers of white pine to the necessity for immediate action as soon as the disease is discovered.

Soil bacteriology and water purification.—The distribution of pure cultures of nodule-forming bacteria for inoculating legumes has been continued. Perhaps the most interesting feature of the results reported is the benefit due to the pure-culture inoculations where leguminous crops are planted in regions naturally supplied with the proper bacteria. Either the natural forms of the organism are less vigorous or they are not present in sufficient numbers to produce the best results. Cooperative studies are under way in a number of places with special reference to bacterial development and nitrification in soils.

DRUG-PLANT INVESTIGATIONS AND STUDIES OF POISONOUS PLANTS.

DRUG-PLANT INVESTIGATIONS.—The work on drug plants and drug-plant crops has covered investigations and studies on camphor, work in connection with the growing of various types of red peppers, investigations of hops, studies of tannin plants, studies bearing on various changes in lemons due to methods of handling, studies of perfumery plants, and tea culture. The outlook for the camphor industry in this country continues bright, in spite of the fact that the price of imported camphor has fallen from the abnormally high figure which was quoted when the work was begun. Private capital has in large part relieved the Department of further work with this crop, with the exception of certain studies having for their object the determination of questions bearing on the importance of the selection of stock for propagation, with a view to increasing the yield of camphor.

For several years cooperative work has been carried on with the farmers of South Carolina in encouraging them to grow certain types of peppers as a feature of diversification. As a result of this work, the farmers this past year produced about 50,000 pounds of dried pods. The crop seems well adapted to the agricultural conditions of the region, and the labor problems have been easily solved. This industry, although a small one, is practically on its feet, and it is believed will be able to largely take care of itself in the future.

The hop work has had for its object the study of individual plants with reference to their yield and quality, in the hope of improving the character of the hop output. Studies of the relation of hop constituents to flavor and other important properties have been continued.

The increasing scarcity of natural sources of tannin material has resulted in a corresponding increase in the importation of tanning extracts, barks, etc., from abroad. It is believed that a considerable portion of these importations might be rendered unnecessary by producing such crops at home. Work is under way along this line, with promising results.

The cooperative tea work is still confined to South Carolina, the small experiments at Pierce, Tex., having been discontinued because of the unfitness of that situation for the work. The crop for the past season in Doctor Shepard's gardens has been excellent and will aggregate about 12,000 pounds of first-class tea. The future of the industry in this country will depend in part upon the elimination of costly labor processes by the development of suitable machinery for handling the crop at all stages. At present the pruning and picking are hand processes. During the year tea-pruning machinery has been devised and tested, with promising results, and it seems probable that next year it will be feasible to do all the pruning by power machinery, thus eliminating one of the great items of hand labor.

STUDIES OF POISONOUS PLANTS.—Studies of poisonous plants during the year have been confined to various phases of the loco work, studies of larkspur poisoning, cooperation in the National Forests to prevent injury to stock through poisonous plants, and some special investigations of Indian corn in its relation to the pellagra disease.

Studies of larkspur poisoning have been continued. This is one of the most destructive factors which the stockmen in certain parts of the country are called upon to meet. A field station has been established at Mount Carbon, Colo., where during the past year investigations have been carried on with the various forms of larkspur and other poisonous plants which occur in the flora of that region. Cooperative work with the Forest Service has led to an expert of the Bureau of Plant Industry traveling through certain of the forests for the purpose of pointing out areas dangerous to stock and to recommend in some cases a change of location of trails, so that these poisonous areas can be avoided. In some cases it has been possible to avoid such areas by means of drift fences and of fences inclosing small areas which were especially dangerous. In this way much valuable aid was given to the stock interests.

The disease known as pellagra is a matter of serious public concern, and while the disease itself is not being studied by the Department, it is important to the work of the Department from the fact that it is suspected that corn may have some relation to it. The scope of the investigations along this line, as already pointed out, covers the determination of the relation of Indian corn to the malady.

TOBACCO INVESTIGATIONS.

During the past year the tobacco work has been conducted in the States of Massachusetts, Connecticut, New York, Ohio, Kentucky, Maryland, Virginia, North Carolina, Florida, Georgia, Alabama, and Texas, and has dealt with improved methods of growing, curing, and handling the crop, this work including fertilizer and crop-rotation experiments, breeding and seed selection, laboratory studies on the quality as affected by composition, and methods of combating important diseases.

After several years of laboratory and field experiment a simple and comparatively inexpensive method of introducing artificial heat into the curing shed has been devised, and it is believed that this method, with possibly some further minor modifications, will provide an effective means of combating pole sweat and other troubles during the progress of the curing. In New York the fertilizer tests have demonstrated to both the grower and the buyer that the yield and quality of the product can be economically improved by the use of the formulas recommended. The growers are also being taught the value of winter cover crops for their tobacco lands.

In Florida and Georgia it has been found that the most effective method of controlling the troublesome nematode or root knot of tobacco, and thereby mitigating the damage from the Granville wilt, consists in thoroughly clean cultivation in the late summer and early fall, keeping the grass and weeds down, and occasionally stirring the soil throughout the winter.

Work in the export, manufacturing, and bright tobacco districts has been continued on much the same lines as in the past, the primary object being to develop by experiments and to illustrate by demonstrations the best all-round practice for the tobacco farmer to follow in the use of fertilizers and the rotation of crops to secure the maximum results of crop yield and to maintain or build up the general fertility of the soil. The systematic introduction into the rotation of grass and leguminous crops for the joint purpose of supplying feed for live stock and of improving the soil is recognized as one of the most important needs, particularly in those sections where dark tobacco is produced.

SUGAR-BEET STUDIES.

The work on sugar beets has been continued along lines similar to those previously pointed out. The encouragement of sugar-beet seed production is being continued. Through work at a number of stations valuable hybridized strains of beet seed are being produced, and some of them are already in the hands of commercial growers, who are offering American-grown seed of high quality for sale. The work on the production of single-germ seed is being conducted with promising results. It is hoped, by securing special strains of beet seed, to reduce the cost of growing sugar beets and to extend the industry into certain sections where the soil and climatic conditions are at present unfavorable for the best development of the strains now generally used. In all the work involving seed production, methods of siloing seed beets are receiving a great deal of attention. Further work has been continued in the matter of improving cultural methods in connection with the growing of this crop. Preparation of the seed bed, planting the seed, care of the beets, and harvesting are all under experimentation and demonstration. Crop rotation is another important matter being considered in connection with the growing of the beet. New areas not previously devoted to the growing of sugar beets are being tested from year to year, with a view to the extension of the industry. These tests are made as far as possible under field conditions, and if the results are promising the tests are repeated for several years in succession. By this work there have been located a number of areas that are very promising for the extension of the sugar-beet industry. In conducting these experiments consideration is given as far as possible to the other conditions necessary in sugar-beet production, such as the presence of lime, rock, water, etc.

The use of the by-products of the sugar beet, so far as they are known at the present time, was exhaustively considered in the last Yearbook of the Department, and indicated that in the West lime should be more generally used as a soil improver, as all of our tests show that it has a decided beneficial effect upon the physical condition of the soil.

Special attention has been given to the diseases of the sugar beet, as these maladies in certain sections are very destructive. Root-rot, crown-rot, damping-off, and other diseases of the sugar beet are receiving careful attention. Diseases of plants grown in rotation with the beet have also been studied.

FIBER INVESTIGATIONS.

Many plant fibers and many questions pertaining to fiber production have been investigated during the past year, but attention has been directed especially to hemp and flax, which, aside from cotton, are regarded as the most promising fiber-producing plants for this country.

Hemp.—The preliminary experiments in the cultivation of hemp in Wisconsin in 1908, in cooperation with the state experiment station, gave very encouraging results not only in the destruction of Canada thistle and quack grass but also in the production of fiber. In spite of adverse weather conditions for retting, more than 9,000 pounds of fiber were obtained from 6 acres. This average yield of a little more than 1,500 pounds per acre compares very favorably with the average of 1,000 pounds per acre on the best farms of Kentucky. The hemp was dew retted on the land where it grew, as is the common practice in this country, returning to the soil most of the fertilizing elements taken up in its growth.

Experiments have been continued in Wisconsin in 1909. The severe drought in summer prevented the full development of the hemp, but it has given good results in killing Canada thistle and quack grass. Improved methods used in harvesting these experimental fields this year will reduce very materially the cost of handling the crop.

Machine brakes for preparing hemp fiber are replacing the slow hand brakes, and in some instances, at least, they are doing not only more work but much better work. The satisfactory results with American hemp binder twine, which has been placed on the market during the last two years, give promise of an extensive market for fiber of medium grades suitable for this purpose.

Flax.—Flax cultivated for the production of fiber in this country is grown from seed imported from Belgium, Holland, or Russia. Seed, as well as fiber, is obtained from the crop, but without selection the seed has deteriorated so that it does not produce good crops after the second or third generation. Improved varieties of flax for seed production have been developed by careful selection of the experiment stations in Minnesota and North Dakota, but there has been little demand in those States for flax grown primarily for fiber with seed as a by-product. Work has now been undertaken by this Department with a view to the development of improved American varieties of fiber types of flax, and the initial selections have been made in the fiber-flax fields of eastern Michigan.

The introduction of a successful flax-pulling machine and new methods for preparing the fiber more cheaply than heretofore give added importance to this work at the present time. It is hoped that with the improvements in the production of hemp and flax in this country these fibers may win back some of the uses demanding strength and durability which have been usurped in recent years by imported fibers of inferior quality.

FRUIT MARKETING, TRANSPORTATION, AND STORAGE INVESTIGATIONS.

The work in connection with the extension of fruit markets has been considerably enlarged during the year. It includes an investigation of cold storage, of transportation, and of the methods of handling the fruit in preparation for market. There have been a large number of requests from fruit growers' organizations, shippers, and transportation companies for an extension of this work to different parts of the country.

Lemon-handling problems.—The California lemon crop amounted approximately to 6,200 carloads in the year ended October 31, 1909. The imports from Italy were equivalent to over 5,000 carloads in the fiscal year 1909. The American lemon as a crop is superior in grade and equal in quality to the European fruit. The industry is increasing steadily in volume. So far as the fruit is concerned the extension of the American lemon trade depends on having lemons that can be laid down in all of the markets of the country in sound condition. In response to the requests of the California growers and shippers, the Department, in cooperation with the leading growers and organizations, is determining the factors that govern the keeping quality of the California lemons. The results so far obtained show that the

American lemon has splendid keeping quality and that the fruit may be shipped in sound condition throughout the United States if it is handled without bruising in the fields and curing houses. As a result of the work already done important changes are taking place in the handling of the crop in California.

CALIFORNIA GRAPE-SHIPPING PROBLEMS.—The shipments of table grapes from California approximate 4,000 carloads. These shipments may be doubled or even trebled when the young vineyards come into bearing. The imports of grapes equaled over 1,000,000 cubic feet in 1909, or the equivalent of about 1,500 carloads. At present the California crop has to be marketed in sixty days. It will be helpful and practically necessary to extend the marketing season over a greater length of time when the young vineyards come into bearing. An investigation has been commenced to determine the relation of the methods of handling and shipping the grape to the losses that occur in transit, and to devise methods under which the marketing season can be lengthened and the marketing area widened. This work has the hearty cooperation of the growers, shippers, and transportation companies, and has already improved the methods in the industry.

FLORIDA ORANGE WORK.—The Florida orange handling and transportation work was continued during the shipping season. The results have been as clear cut as those which have revolutionized the methods of handling and shipping the oranges in California. They show that the losses in transit are largely due to the rough handling of the fruit in preparing it for shipment. In California the work has been worth at least $1,000,000 a year to the industry. In Florida it has been much less effective, though the methods are changing slowly and the old packing houses are being remodeled.

IMPROVEMENT IN FRUIT TRANSPORTATION.—During the year a more extensive study has been made of the effect of cooling perishable fruits to a temperature of about 40° F. before shipment. At present fruit, unlike meat products, is loaded for shipment in a warm condition. The temperature of the fruit is reduced slowly in transit, but not fast enough to prevent the rapid ripening of some of the fruits and the decay of others. The preliminary work along this line had shown that fruit that ripens can be marketed over wider areas when cooled before shipment, and that it can be allowed to remain on the tree until it reaches a higher quality before it needs to be harvested.

It has not been possible to conduct these investigations satisfactorily, as cold-storage facilities were usually lacking where needed. A refrigerating plant has been designed and constructed in a specially built car to meet this need. The plant can be moved to any part of the country. It can be used in the experimental work to refrigerate fruit in a warehouse alongside or in a car by blowing cold air from the coil room of the plant to the warehouse room or to the car containing the fruit. The plant has been located at Riverside, Cal., where a study has been made of the effect of cooling oranges at different temperatures and with different degrees of rapidity. Later in the season it will be used in the grape-shipping investigations in central California.

These investigations are revolutionizing the methods of shipping fruits in some parts of the country. They have shown not only that the losses in transit can be reduced and the marketing area extended, but also that the freight-carrying capacity of a car can be increased by loading the packages closer together, and that possibly there may be a saving of ice in the car in which the fruit is loaded in a cold condition. The work has had the cooperation of the growers, shippers, and transportation companies. The transcontinental lines running out of California are now constructing plants where train loads of fruit can be quickly cooled after loading, and several plants have been constructed by organizations of growers in connection with their packing houses.

PROGRESS IN GRAPE INVESTIGATIONS.—The viticultural investigations on the Pacific coast to determine the adaptability of resistant stocks to soils and the congeniality of the leading varieties to such stocks is progressing satisfactorily. The cooperative vineyards in California now contain 415 vinifera and 277 resistant varieties, with 271 vinifera varieties grafted on resistant stocks. The study of the Rotundifolia type of grape in the South is progressing as rapidly as the funds available permit.

ADAPTABILITY OF FRUIT VARIETIES.—The study of the adaptability of fruit varieties to soils and climatic conditions has been continued in Arkansas, the fruit crop of most of the other sections of the central West having been injured by spring frosts. The dry-land fruit studies have been extended, and an effort is being made to show the forest rangers how to grow fruits and ornamental plants around their cabins.

PECAN CULTURE.—In the pecan investigations in the Southern States special attention is being given to the investigation of the self-fertility of varieties and to the discovery and study of varieties adapted to different sections.

ARLINGTON EXPERIMENTAL FARM AND HORTICULTURAL INVESTIGATIONS.

The usefulness of the Arlington Experimental Farm to the Bureau and to the Department as a whole increases each year. As a result of tile draining and the plowing under of leguminous and other crops for green manure, the productiveness of the soil has been greatly improved. Not only has crop production been increased thereby, but the physical condition of the soil has been modified, so that it is less affected by excessive rains or by drought than formerly. It is now possible to cultivate during seasons which were prohibitive of crop production prior to the establishment of these improved practices.

Plant-nutrition investigations in the trucking areas of Virginia and Long Island have progressed far enough to demonstrate the advantages of a systematic crop rotation in which a catch crop turned under plays an important part. The decomposition of vegetable matter in the soil stimulates desirable activities and corrects the evil effects of the excessive use of high-grade fertilizers.

VEGETABLE TESTING.—The results of the year's work in testing some 1,200 so-called distinct varieties of vegetables have shown that in a great many cases seedsmen send out under varying varietal names stocks whose only difference is the degree to which they are uniformly of the same varietal character and that the use of different varietal names to distinguish what are in reality simply different grades or strains of the same sort is a very common practice of even our best and most reliable seed firms.

Recent cultural studies of potatoes have disclosed the fact that certain varieties possess greater drought-resisting powers than others. The economic importance of a further study of varietal adaptations to varying soil and climatic conditions can hardly be overestimated. The selection of varieties best suited to each important potato-growing section of the United States would materially augment the income from this crop.

COOPERATIVE MARKETING OF CROPS.—One of the most promising tendencies of the day is the spirit of cooperation and mutual helpfulness which is beginning to manifest itself among the producers of truck crops. The successful organization and working of cooperative marketing companies or exchanges by farmers have proved the possibility as well as the desirability of a system of marketing which shall have headquarters at the point of production. Products can be distributed more economically and more satisfactorily to the consumer from the point of production than from a city distributing center. The work of one of these cooperative organizations has come under the notice of the Department during the past year. Of an aggregate business of $2,500,000, this organization was able to handle 90 per cent of its work from a central office in the growing district on an f. o. b. shipping-point basis. The prices received were equal to New York and Philadelphia prices in all cases. The net results of these operations were the elimination of losses which inevitably result from consignment, practically cash transactions for all sales, and the saving of transportation from the field to the center of distribution in one of the large cities, which in this case added $150,000 to the farmers' profits on the year's business.

DOMESTICATION OF THE BLUEBERRY.

Experiments in the cultivation of the blueberry have been continued. A report on these experiments, now in preparation, will contain the detailed information needed by private experimenters to enable them to handle these peculiar plants with success. The failure of the experiments with blueberries at some of the agricultural experiment stations has been due chiefly to the fact that it was attempted to grow these plants in the ordinary fertile garden soil suited to other small fruits. From the experiments now made it appears that the blueberry not only prefers an acid soil but will not thrive in any other than an acid soil. In the choicest type of agricultural land, mellow, well drained, well aerated, fertile, and of neutral or slightly alkaline reaction, so that the nitrifying bacteria perform their work with the highest degree of efficiency, the blueberry either dies or maintains a feeble and fruitless existence; but when grown in a raw, acid soil, such as is commonly found in swamps, or on moist mountain slopes, or on the surface of sandy oak or pine lands, the blueberry takes on a luxuriant growth, a fact that is remarkable when one considers that these same soils are one of the poorest types for ordinary agricultural purposes, and that because of their acidity the growth of the nitrifying bacteria, so essential to most crops, is very greatly reduced or altogether inhibited.

The prospective addition of the blueberry to our list of cultivated fruits is of interest not only because of the deliciousness and popularity of the blueberry as a fruit, but also because it means the utilization of land now regarded as almost valueless for agricultural purposes. There is every reason to believe that the application to field conditions of the experimental results thus far secured will place the possibility of the commercial cultivation of the blueberry on a new basis.

DEPARTMENT GREENHOUSES, GARDENS, AND GROUNDS.

The work of maintaining and caring for the Department grounds and greenhouses has continued satisfactorily. A number of changes are under way as a result of clearing the grounds surrounding the new building of the Department, and these will greatly improve the general appearance of the Department grounds. A new range of greenhouses is being erected to take the place of an old range, which will be demolished, and other improvements are being brought about. The work in the greenhouses has progressed satisfactorily, including the improvement of plants by hybridization and the development of new and improved methods of handling greenhouse crops.

CONGRESSIONAL SEED DISTRIBUTION.

The distribution of seeds and plants on Congressional order was continued during the past year along the same general lines as previously. Owing to the higher price of vegetable seeds, the quotas assigned to each Member of Congress were slightly smaller than in former years. The packeting, assembling, and mailing of the vegetable and flower seeds were carried out satisfactorily under contract, as formerly. Particular attention has been devoted to the development of improved methods of cleaning the seed obtained for Congressional distribution, and its quality has been greatly improved thereby. Another line of work connected with the seed distribution which should be mentioned is the effort to bring about the home production of Dutch bulbs in sufficient quantity to build up a new industry. There are sections of the Pacific coast region which seem well suited to the production of these bulbs, and experiments are under way to determine whether their cultivation can be carried out on a successful commercial basis.

PURE-SEED INVESTIGATIONS.

The seed-testing laboratories of the Bureau have continued their efforts in the interest of pure seed for the farmer. Three branch laboratories are now in operation, in cooperation with the experiment stations of Nebraska, Missouri, and Oregon. At these laboratories, as well as at the main laboratory in Washington, many hundreds of samples of seed submitted by farmers and seedsmen are being tested for the presence of adulterants, as well as for purity and germination, and the results of these tests reported.

In accordance with the authority granted by Congress, samples of seed of forage crops have been collected and examined, purchases being made of those showing signs of adulteration. This work has been conducted along lines followed in the past, the names of firms whose seeds are found to be adulterated being published. It is very gratifying to state that the practice of seed adulteration has in this manner been practically stopped, save in the cases of orchard grass and Kentucky bluegrass, and quite materially reduced even in these cases.

An educational movement for the purpose of encouraging greater interest in good seed has been carried on by means of lectures and lantern-slide demonstrations at farmers' institutes, several weeks having been spent in this work. During the past year opportunities have been afforded persons interested in pure-seed work to study seeds and approved methods of seed testing in the main laboratory at Washington. Representatives from several prominent seed houses preparing to do their own seed testing were among the number, and as a result several have purchased apparatus preparatory to fitting up laboratories in their own establishments. Hundreds of authentic samples of common weed and economic seeds, put up in vials labeled with their common and scientific names and packed in herbarium trays, have been distributed, to be used for reference, thus enabling individuals to become familiar with the more common economic seeds and their impurities.

PAPER-PLANT INVESTIGATIONS.

A good beginning has been made in the investigation of cornstalks, rice straw, and other similar crop materials to determine their value for paper manufacture, in accordance with a recent appropriation for this purpose by Congress. Arrangements have been made for a series of field and laboratory experiments to determine the comparative fiber value of the crops mentioned and to secure proper material to serve as the basis for tests on a large scale in cooperation with paper manufacturers. In the laboratory tests, cooperation with the Forest Service and the Bureau of Chemistry will be entered into. The object of these experiments is to show decisively whether or not paper can be economically produced on a large scale from cornstalks, broom-corn stover, rice straw, and other crop materials which are at present more or less waste products.

COTTON STANDARDIZATION.

During the past year substantial progress has been made toward the establishment of official grades of American cotton, in accordance with law. In February, 1909, a committee of representative cotton men, called together in Washington, unanimously recommended the adoption of official cotton grades and submitted a set of types which in its opinion fairly represented the grades sought to be established. Preparations for the promulgation of these grades have been going steadily forward, and it is expected during the present year to place sets with the principal associations, organizations, exchanges, and agricultural colleges most interested in cotton. It is also hoped that the work of more generally distributing the grades by sale may soon be undertaken.

GRAIN STANDARDIZATION.

The work in grain standardization during the past year has continued to bring forth much valuable information and many data relating to the value of the factors of quality and condition in fixing commercial grades of grain and the importance to the American public of those grades, as well as of the methods and practices of fixing them. Efforts have been exerted toward bringing about a better understanding of the various phases of the problem of grading commercial grain, and much good has been accomplished. As the possibilities of the work come to be better understood, it is fast gaining the support and cooperation of progressive grain merchants, grain-elevator owners, and grain-carrying railroads, and there is a growing appreciation of the Government's interest in commercial grain problems.

The work of investigating the condition of American cargoes of grain on arrival at European ports during the past three seasons, as mentioned in the last report, has been brought to a conclusion, and the data bearing upon the important phases of that work, together with other information collected which is of value to the grain interests, are now being prepared for publication.

The results of the grain-standardization work are being manifested in many ways, principally in an increased activity among influential grain interests toward bringing about more satisfactory conditions with relation to grain-inspection practices, with the noticeably desirable result that the grain trade generally is beginning to realize the seriousness of the question. The introduction into the grain business by the Department of Agriculture of a quick method for testing moisture in grain has proved an important factor in causing greater care to be taken of corn on the farm, as it has been instrumental in educating the grain buyer and handler with regard to the moisture content and its effect upon grain values. This has no doubt been an active influence in the disappearance of the open-rail corn-crib or pen from the corn belt. Railroad and elevator companies are becoming interested in the work, because of the close relation of some of its phases to a subject of much interest to them, known as "natural shrinkage" in commercial grain.

SPECIAL PLANT INTRODUCTION AND TESTING GARDENS.

The special field gardens of the Bureau have made good progress during the past year and have proved a valuable aid to the various lines of investigation conducted throughout the country. The Plant Introduction Garden at Chico, Cal., has been improved during the year, and arrangements have been made to undertake definite work at that point in the extensive propagation of the various seeds and plants secured through introduction and otherwise. The services of a plant breeder of wide experience have been secured for this work.

The South Texas Garden, at Brownsville, has been further developed during the past year and has increased its efficiency in aiding the settlers in the surrounding country. An investigation of the possibilities of southern Texas for citrus-fruit culture was made during the year and the results published. The Subtropical Garden, at Miami, Fla., has been practically discontinued, the greater portion of its work having been turned over to the local authorities of Miami under a cooperative arrangement. This plan will enable the Department to direct its energies in southern Florida to a general series of field experiments and investigations, thus affording greater aid to the region as a whole.

FARM MANAGEMENT.

The Bureau has continued to study the methods and practices on the most successful farms throughout the country, and a great quantity of valuable information has been acquired, which is being put to practical use by way of demonstrations, experiments, etc. In addition to the general lines of farm-management work, the Bureau is making special studies of farm practice in the use of fertilizers; the field management of weeds and their relation to tillage practices; the production, curing, and marketing of hay; the economic handling of pastures; and the production of strains of cassava for the South that will reproduce true to seed. Three such strains of cassava have been produced and are now being propagated on a considerable scale. By propagating this crop from seed instead of from cuttings the region to which it is adapted can be greatly extended, especially in those sections of the Gulf coast where corn does poorly.

USE OF LEGUMES IN THE SOUTH.—Our work during the past few years in encouraging the use of leguminous crops in suitable rotations for the rebuilding of exhausted soils is showing marked results. As compared with five years ago, cowpeas are more extensively grown all over the South, and improved methods of saving the seed through the use of machinery have become established in various localities, particularly in eastern Tennessee and southeastern Missouri. Other leguminous crops have become established and are being used in rotations in scattered sections. The extended use of vetch is pronounced in North Carolina and South Carolina and parts of Georgia and Louisiana, while bur clover prevails in northern Alabama, crimson clover in Virginia, Japan clover in Louisiana, Arkansas, and Mississippi, and alfalfa in the black, waxy, and alluvial soils of all the Southern States.

FARM PRACTICE IN PRODUCING FORAGE FOR STOCK.—Our work in the West and also in New England has been directed more especially toward improved methods in the use of suitable forage crops for sheep and hogs and the devising of proper cropping systems in stock production. The sheep industry in the New England States, for some time thought decadent, is proving profitable under capable direction and is a type of farming well suited to much of the rough pasture land of those States. There is also a demand for cheap, light-weight, native pork in New England, and the value of such pasture crops as rape, clover, and peas is being brought to the attention of the farmers.

CROPS FOR CUT-OVER AND STUMP LANDS.—Observations of the sandy jack-pine cut-over lands in Michigan, Wisconsin, and Minnesota have been continued and work has been begun in the growing of hairy vetch as a seed and forage crop suitable for these lands. Large quantities of hairy vetch are now grown throughout the Atlantic Coast and Southern States as a soil-improving, forage, and winter cover crop, the seed for which is nearly all imported. The light, sandy soils of the North promise to be well adapted to this crop. Another important problem in some of the central-northern States, where lumbering operations have been extensive, is the successful handling of stump lands. The value of various stumping machines and equipment, as well as of dynamite and certain other powerful explosives, in the economic clearing of these lands for settlement is being studied.

VARIOUS FARM-MANAGEMENT PROBLEMS.—In the Pacific Northwest special attention is being given to improved methods of handling the wheat lands of eastern Washington and Oregon and of northern Idaho and to the working out of practical cropping systems for the farms on the new irrigation projects of this territory. In certain sections of the Middle West the soil is peculiarly adapted to corn, and exploitative systems of continuous corn culture, in occasional alternation with oats, have frequently been continued until the yields of both crops were so low as to make this type of farming entirely unprofitable. The necessity for changing this type of farming to some profitable kind has forced itself on landowners, who have applied to the Department for plans. To meet this demand a paper outlining methods of successfully attacking the problem was issued.

COST OF PRODUCING FARM CROPS.—The cost of producing farm crops and the time necessary to perform certain farm operations are being studied as a basis for making farm plans. In this work the Bureau is cooperating with successful farmers in different sections of the country, who send in daily reports of work done. Bookkeeping, while a vital part of successful business enterprises, has never been popular on the farm because of its complexity. A simple system of farm accounts and supplementary records has been worked out and tried on a number of farms during the past year, with most promising results. The study of farm machinery and of the relation of machinery to farm management and farm profits has also been studied.

WORK WITH THE PRICKLY PEAR.—In southern Texas the prickly pear has proved a valuable farm forage crop for cattle, sheep, and swine and the best insurance against stock famine that can be grown in that section. It has been proved that the prickly pear, well cultivated, will seldom, if ever, suffer from drought in southern Texas, while the uncultivated cactus often does. By breeding the least spiny, most prolific, and hardiest native pear with the spineless cultivated forms it is hoped to secure a prolific spineless form that will be hardy in that section; but until this is accomplished the spiny native pears should be used. About 10 tons of cuttings of the spineless varieties of pear were distributed during the year to settlers in the less frosty sections of the country, where there is a probability of their successful growth.

FARMERS' COOPERATIVE DEMONSTRATION WORK.

The demonstration work among southern farmers has made rapid strides during the past year. Any observer of farm crops in the United States has noticed that a few farmers secure a good yield almost every year regardless of seasons or pests, while the great majority of farmers make only moderate returns the best seasons and between these secure only partial yields or have total failures. The advent of the boll weevil in the cotton States accentuated this situation and enormously multiplied the failures until a total wreckage of that great fiber industry was threatened. Primarily to meet this condition the Farmers' Cooperative Demonstration Work was inaugurated upon an extensive scale by the Bureau of Plant Industry in January, 1904.

Plan followed in the work.—The central feature of the work consists in placing a practical object lesson before the farmers through demonstrations made upon their farms, exemplifying the best and most profitable methods of producing the standard farm crops. It is an effort to show the farmer a way to help himself under such direction and guidance as this Department may be able to furnish. The most important factor in the improvement of agricultural conditions is the man on the farm. Unless he can be aroused and impressed with the necessity of securing better results, there is little hope of permanent reform in methods. The evolution in the man must come by personal achievement, and the only achievement open to the average farmer is greater accomplishment upon his farm. A better crop, or a better farm, or better conditions of life, give him local prestige and leadership. As far as practicable, it is the plan of the work to secure enough object lessons in each county to permit one or more to come under the immediate observation of every farmer, and then to secure the cooperation of all for further trial. This method of teaching appeals as forcibly to those who do not read as to those who do. It reaches and convinces all classes and apparently is the only method by which rapid and radical changes of methods long established can be secured.

Development of the work.—If the increasing demand for the work is a measure of its value, then it is certainly accomplishing the objects for which it was inaugurated. It has increased in the past six years from 1 field agent to 362, and from 1 farm under supervision to more than 60,000 farms, including those classed as cooperating. The work is now being conducted more or less extensively in twelve States, and has been influential in securing to a considerable extent the addition of humus to the soil and an improvement of soil conditions, a better preparation of the soil for crops, the use of better varieties of cotton and corn, almost universal attention to seed selection, more intensive cultivation, the better storing of crops, the production upon each farm of the foods necessary for the support of the families and teams working the farm, more pastures and meadows, more and better teams and implements, more live stock, great improvement in farm and home conditions, more months of schooling, and better rural conditions.

Extension of the work through voluntary contributions.—Agencies other than those of the State have very materially aided the rapid extension of the work. In a large number of counties in Mississippi, North Carolina, Texas, and other States the people themselves have made considerable contributions to secure additional time and service from a local agent of the Department. In other words, when the Department funds were only sufficient to employ a man a part of the time the county supplemented the amount and secured the full services of the agent.

Boys' corn clubs.—In the boys' corn clubs of the Southern States there were enrolled the past year 10,543 boys, who were required to work a plat of ground upon their fathers' farms under instructions from the Department. These demonstrations served a double purpose, practical education and encouragement to the boy and a valuable lesson to the farmer, as the yield of corn on the boys' plats was generally many-fold the average product of the farm. Greater interest was manifested in this work by the citizens of the county than in demonstration work among adult farmers. Ten thousand dollars in prizes were contributed by public-spirited citizens to encourage boys' corn clubs during the past season.

Effect of the work.—The Farmers' Cooperative Demonstration Work as a method of practical instruction has been widely adopted by colleges, normal schools, industrial schools, rural high schools, and some common schools in the management of the farms or plats of land attached. Some rural schools have asked cooperation to work land for instruction, the proceeds to be applied to the purchase of a library or the extension of the school term. In a similar way church societies have placed lands under the demonstration methods to provide funds for special expenses. The work has made a special appeal to the colored farmers and has helped them in improving their farm methods and in promoting better conditions of living.

FOREST SERVICE.

The Forest Service manages a great producing property. It carries on investigations that will enable private property to be put to better use. It seeks to diffuse and get into practice the knowledge which its scientific studies yield. But of first importance is its work in caring for the National Forests.

THE NATIONAL FORESTS AS PUBLIC PROPERTY.

All told, the proclaimed boundaries of the National Forests now include nearly 195 million acres of land. This is nearly 27 million acres more than a year ago. Of the gross area, however, much belongs to States and private persons. Through grants by Congress and the patenting of claims under the land laws there has been alienated about 16 million acres. Many other claims are pending. Altogether the actual National Forest property, exclusive of all alienations and unpatented but valid claims already pending, comprises 147 million acres of land in the continental United States, with 26 million acres more in Alaska. This vast property belongs to all the citizens of the United States jointly, and is in my charge to manage for their benefit, just as the holdings of any private corporation belong to the shareholders and are managed for them by the corporation's officers.

One obvious difference between this productive property which belongs to the public and the holdings of even the greatest private corporations in the land is the far greater size of the public holdings.

The administration and protection of the National Forests cost last year less than $3,000,000, with an additional $500,000 spent on improvements. The cash receipts for the year were not far from $1,800,000.

Of the three principal resources of the Forests—water, forage, and timber—the timber is for the time being the least developed. Receipts are no measure of the present use made of all three resources. Explanation of what the public is getting out of its property—an intelligible statement, in other words, of what truly constitutes the credit side of the National Forest income account—requires that these products be considered separately.

THE WATER YIELD OF THE FORESTS.

From the nature of the case the value of the Forests as regulators of stream flow and conservers of the supply available for irrigation, power, and navigation defies statement in terms of dollars and cents. But there is no important stream in the West whose waters are not through the dry season drawn mainly from the National Forests. The overwhelming weight of common experience as of scientific observation recognizes the important service of the forest in preventing erosion and equalizing the flow of water from mountainous regions. Without the water protection secured by the National Forests, this greatest of western resources would grow progressively more inconstant and less valuable.

But the Forest Service is doing more than merely safeguarding present water supplies. Partly as a result of the work of civilized man, partly as a result of purely natural causes, the forests of the West are almost everywhere not in the best condition. Destructive lumbering, unregulated grazing, insect damage, and fire have all played their part, but fire has been by far the most harmful. Seldom can any extent of forest be found without old burns, or a mountain range that is not scarred by great stretches of unwooded or half-wooded slope. From as far back as the trees bear record, fires have raged in the western timber. During last year the principal cause of fires in the National Forests was railroad locomotives; the second, lightning. Man and nature have both sent the fire to thin or sweep away the protective cover of the mountain sides. But the fires are no longer allowed to burn until they go out or are put out by rain. Vigilant protection is now given the Forests, and this will mean the steady improvement of water conditions in the West.

Regulated grazing also makes for better water conditions. In the Tonto Forest, for example, sheep grazing on certain parts of the Salt River watershed has been found by the Reclamation Service to be injurious to the interests of the Salt River project, and accordingly the Forest Service, after fair notice to the stockmen who have been using these parts of the range, will close them to sheep. This, however, is an extreme case. Usually stock under proper regulations can utilize the forage crop without harm to the water supply, and are permitted to do so under the present system.

Thus the water yield of the Forests is both conserved and improved. Except for an insignificant amount paid for special-use permits by certain power companies, the receipts of the Government from the Forests show not a penny the better for this resource. But the Forests pay their owners, the people, more direct dividends. Not only the users of water throughout the West but all who in turn derive a benefit from the prosperity of these users share in the distribution of profits. As public property the National Forests serve their proper function by contributing to the general welfare. To measure their usefulness by the charges collected would be a very great mistake. Of their three main uses that for water is far more important than their use for forage or for timber supply, yet it results in the collection of almost no charge at all.

THE FORAGE YIELD OF THE FORESTS.

The use of the forage crop of the Forests brings a profit to the public partly through the payment of charges by private individuals for the grazing privilege, but chiefly, as does the water, through the promotion of the general welfare. Though the grazing charges brought into the Treasury of the United States over $1,000,000 last year, the administrative expense of regulating the use of the range cost the Government nearly as much. In truth, grazing fees are fixed with a view primarily to meeting the expense of regulation, not to raise revenue. The charge for the grazing privilege was far lower than that usually paid by stockmen to owners of private land. Were the National Forests the property of an ordinary corporation, concerned not with the interest of all the people but only with that of a limited body of shareholders, grazing might have furnished at least twice as great an income as it has furnished. In other words, had the stockmen paid the full market value of their use of the National Forests, the receipts from all sources would very nearly, if not quite, have balanced the cost of administering and protecting the Forests.

Such a commercial policy was not pursued because it would have meant sacrifice of an opportunity to promote the public welfare in the best way. It is of course just that the stockmen who profit by use of the National Forests should make a reasonable return for the privilege which they receive: but it is of first importance to prevent monopoly of the range by a few men, and make it do its share toward building up stable communities of independent American citizens. Hence the charge is fixed at what the man newly starting in business and without much capital can reasonably pay; and room is made for such men on the National Forest range, if necessary, by reducing the number of stock large owners are allowed to graze.

Thus the forage yield of the Forests, which sufficed for nearly 7,700,000 sheep, 1,500,000 cattle, 90,000 horses, and 150,000 hogs and goats, was utilized by more than 27,000 individuals and concerns, besides furnishing free grazing for milk cows and work horses of settlers, prospectors, travelers, etc. For every permit allowing the grazing of 4,000 or more sheep and goats there were 7.4 permits for 1,000 head or less, and for every permit allowing 200 or more cattle, horses, or hogs there were 9.4 permits for 40 head or less. The average number of sheep and goats to each permit was 1,541 and of cattle and horses 71. Thus what stands to the credit side of the grazing account is the wide usefulness of the range and the healthy upbuilding of communities, rather than the $1,000,000 of receipts.

THE TIMBER YIELD OF THE FORESTS.

The use of National Forests as sources of timber supply is less developed than their use either for water or for forage. The reason for this is obvious. The grazing industry in the West has expanded until it has reached almost everywhere the full capacity of the range in its present condition. The profitableness of irrigation and the steady demand of home makers for new land have led to water appropriations on a large scale, while power development, though in its infancy, is already seeking strategic positions and preparing for widespread application. But the timber of the National Forests is, comparatively speaking, in little demand. Its day has not yet come.

The additions made to the Forests last year brought the total estimate of timber to about 400 billion feet, exclusive of Alaska. The cut of the year was not quite 460 million feet, or a little over one-ninth of 1 per cent of the stand. In other words, it would take nearly 900 years, at this rate of cutting, to remove the present stand. Since the forests grow, after such cutting as takes place under Forest Service methods, at the rate of about 1 per cent of the original stand annually, only about one-ninth of the potential forest crop was harvested.

The cut of last year, however, was abnormally small. It was even less than that of the previous year, which in turn, as I explained in my Report for that year, was restricted in accordance with a policy dictated by the public interest. As the methods of the Forest Service are worked out, and as the demand for National Forest timber becomes greater because of the diminishing supply in private hands, it will be wise to encourage such sales as will serve the people, while holding sufficient timber in reserve and providing safeguards against monopoly control of the market. Already it is clear that the cut of the coming year will be much greater than that of the year just closed.

EFFECT OF GENERAL CONDITIONS ON NATIONAL FOREST BUSINESS.

The small timber cut of last year illustrates the fact that National Forest business is affected by the same conditions as business generally. As with private producing property, the use made of these public Forests varies with the commercial and industrial activities of the nation. The depression which followed the panic of 1907 is recorded in the totals of National Forest business, just as in the totals of other kinds of business. But it is a striking fact that National Forest business suffered what was rather a check upon its rate of increase than a serious retrogression.

The receipts from the National Forests in the fiscal year 1907 were about $1,530,000, an increase over those of the previous year of over 100 per cent. In the fiscal year 1908 they were about $1,790,000 and in that of 1909 about $1,765,000. It is now clear that during the present year they will reach a higher figure than ever before. In other words, instead of falling off violently in response to the period of business depression they remained nearly stationary during the two bad years and are now resuming their advance.

This relative stability of National Forest business in the face of adverse general conditions unquestionably points to increasing use of the Forests. What would have shown normally as a considerable gain in receipts here appears in the prevention of any marked decline. But another cause also is involved. Beyond a doubt the fact that National Forest business has other than purely commercial ends helps greatly to maintain a steady volume of use. This is not without its importance to those who make commercial use of the Forest resources and to business interests generally. In certain ways the Forests worked as a counterpoise to the general business depression. This will appear when the principles which govern the disposal of grazing privileges and the making of timber sales are considered.

From these two sources come almost all the National Forest receipts. Grazing, as has already been said, paid last year a little over $1,000,000; timber sales, $700,000. In the case of neither is the obtaining of the largest possible revenue the administrative aim. Had the stockmen of the West faced the necessity of paying grazing fees raised to the limit of what they could afford, the disturbance which began in the fall of 1907 must have had a far more serious effect on their industry, and the consequences would have been felt later in the prices of beef and mutton to the consumer.

So, also, in making sales of National Forest timber, the best interests of the consumer furnish the guiding principle. Small sales are preferred to large sales, though they mean a lower price for stumpage, because they promote local enterprises, tend to prevent market monopoly, and at the same time make possible better provision for the welfare of the forest. It is the operator on a large scale who shuts down when times are bad. The little mill continues to run, continues to give employment to its hands, and continues to turn out material for local use.

Had it not been for the large number of small sales a very great falling off in the cut of National Forest timber would probably have marked the year. Operations under large sales usually extend over from three to five years, so that the cut of each year includes much timber that was disposed of under sales of previous years, and the amount cut in a given year may be either much more or much less than the amount sold. In the fiscal year 1907 over 1 billion feet of timber was sold, but less than one-fifth of this amount was cut under sales. In 1908, 386 million feet were sold and something under 393 million feet were cut. But in 1909 the sales fell below 287 million feet, though the cut was 353 million feet. This was a decrease of 26 per cent from the sales of the previous year. Yet the number of sales for less than $500 worth of stumpage was within 1.2 per cent of the number for 1908. In other words, the small sales remained nearly constant, while the larger sales fell off heavily—as would be expected in a year of dull business. In short, had it not been for the steady demand of small purchasers and for the cutting under sales made before the trade reaction set in the National Forest timber business would have been quite as stagnant in the fiscal year 1909 as that of the lumber business generally.

Since but a small fraction of the potential timber crop of the National Forests is now cut, the most important duty which its care immediately imposes is the protection of the great supply on hand. As producers of timber these Forests should be considered a property the development of which has hardly begun. With increasing population, better means of transportation, and acute general demand when other supplies run short, the country will have abundant future use for this timber. That the sales are at present so small is no reason against taking the very best care of what will within a few years repay with heavy interest all that its care is costing. Private owners of valuable timberlands are well content to hold and protect them. It is well that the public can do the same.

WORK OF THE YEAR.

A notable change in organization was put into effect on December 1, 1908. Previous to that time all the work on the Forests had been directed immediately from Washington. Now six district offices, located at Missoula, Mont.; Denver, Colo.; Albuquerque, N. Mex.; Ogden, Utah; San Francisco, Cal.; and Portland, Oreg., have charge of the execution of all National Forest business. Only the larger questions of administrative policy are now handled in Washington. In consequence, business is transacted with far greater dispatch; close touch between office and field is easily maintained, and efficiency along all lines of work has been vastly stimulated. It is already clear that this was the most important forward step ever taken by the Forest Service—taking the Department to the people.

The cost per acre of National Forest administration was virtually the same as last year. Appropriations 14 per cent greater were applied to a gross area 11 per cent greater at the beginning of the year, and 18 per cent greater at its close, than at the same times the year before. On the basis of the gross area under administration at the end of the year, the expenditure for all purposes, including improvements, was 18.3 mills per acre; or, on the basis of the area exclusive of alienations, less than 20 mills. Since to protect the National Forests it is usually necessary to protect also alienated land within the Forests, the first figure more fairly represents the facts. In either the expenditure was less than 2 cents per acre. This contrasts with expenditures of from $1 to $2 or more per acre, which are annually made upon the highly lucrative forests of France, Germany, and Switzerland.

One-sixth of this expenditure went to making and maintaining improvements—chiefly trails, roads, telephone lines, and quarters for Forest officers. These improvements benefit both the Forests and the public. They make protection of the Forests far more effective and economical, provide better facilities for the transaction of business with Forest users, and serve the convenience of the public generally. The amount available for this work has only partly met the most urgent demands. If the Forests are to be adequately cared for and their usefulness is to be developed, they must be far better equipped with means of communication and transportation than they now are. The money thus spent is in reality an investment by the Government for the betterment of its own property and for the general welfare.

Deducting the cost of improvement work, there is left something over 1½ cents per acre as the cost of administration and protection. This includes a fair proportion of the general expenses of the Forest Service at Washington, as well as all expenditures made directly on behalf of the Forests. Since all forms of use by the public involve cost to the Government for supervision, and since use is increasing yearly, the amount available for fire protection is dangerously small and certain to be smaller unless the appropriations for the Service keep pace with the growth in use.

The desire of associations of timber-land owners in the West to give organized protection to the holdings of their members opened the way to an arrangement for joint action against fires by the Forest Service and certain of these associations where the private timber involved was within or near National Forest boundaries. An embarrassing difficulty arose from the fact that these private owners wished to spend more money per acre for fire protection on their own land than the Government had available for the Forests. This compelled the lumbermen to choose between paying part of the cost of protecting the public holdings and giving their own holdings less protection than business prudence called for. The situation illustrates how small, in proportion to the work to be done, is even the most liberal provision made in the past for the needs of the Forest Service. Agreements for cooperative fire protection were, however, concluded with the Potlatch, Coeur d'Alene, Pend Oreille, and Clearwater Timber Protective Associations, in the State of Idaho.

The forest-fire season of the summer and fall of 1908, disastrous throughout the country, brought relatively insignificant losses upon the National Forests. Statistics of fire losses are kept by the Forest Service not for fiscal but for calendar years. During 1908 fires on National Forests destroyed about $450,000 worth of timber. Of 2,728 fires reported, 2,027 were confined to an area of 5 acres or less.

At the request of the General Land Office claims on National Forests are examined by the Forest Service before patent is issued, in order that the Land Office may be cognizant of any facts bearing on the validity of the claim, which such field examinations may disclose. During the year 5,610 claims were examined and facts favorable to the claimant were reported in 3,003 cases and unfavorable in 2,112. Patents were issued by the Interior Department for 1,583 claims within National Forests, of which 633 were homestead entries, 514 timber and stone entries, and 425 mineral entries. While it is not desired to obstruct needlessly the perfecting of valid claims by bona fide entrymen, the interest of the people in their own property lays upon the Government the duty of protecting the Forests against unlawful attempts to patent the land.

There were listed under the Forest homestead law of June 11, 1906, 1,450 tracts of National Forest land, with a total acreage of about 140,000 acres.

An impression that the National Forests contain large areas of agricultural land to the exclusion of settlement and large areas of untimbered grazing land unjustifiably brought within the National Forest boundaries for the sake of grazing has gained wide currency. To satisfy myself on the ground as to the facts, I made personal investigation of these matters during the past summer in the States of Idaho and Wyoming.

Presumably the time will come when some portions of the present Forests can with benefit to the community be converted into farms. Through dry farming, plant breeding, and the introduction of new forms of useful and drought-enduring vegetation, agriculture is steadily gaining upon the desert, and may be expected to gain on the forest in semiarid regions. Growth in population also will bring an increasing demand for farm land. But it will also bring an increasing demand for timber and water conservation. The present is not the time to decide where the line should finally be drawn.

I found no evidence that the National Forests are withholding from settlement land now demanded for agriculture. As to grazing land, it is sufficient to say that proper administrative control of National-Forest grazing has necessitated the fixing of the boundaries where they now are, that public sentiment in the States visited is strongly in favor of the maintenance of the existing boundaries, and that representations that great areas of land are held for other than Forest purposes are in my judgment wide of the facts.

The total cut of National Forest timber during the year was nearly 460 million board feet, of which over 100 million feet were given away under free-use permits. The receipts from timber sales for the year were about $700,000. Free use of timber was heaviest in

Idaho, with over 18 million board feet, followed by Montana, Colorado, Utah, and New Mexico, with amounts ranging from nearly 17 million to less than 10 million feet. California, Wyoming, and Oregon had each a free-use cut of between 6 million and 7 million feet. The remaining National Forest States follow with less amounts.

Of the timber cut under sales, Montana furnished nearly 86 million feet, or 24 per cent; Colorado 44 million feet, or 13 per cent; California 39 million feet, or 11 per cent; and Idaho 35 million feet, or 10 per cent. These amounts correspond to the following percentages of the estimated stand of National Forest timber in each State: For Montana, three-tenths of 1 per cent; for Colorado, four-tenths of 1 per cent; for California, four one-hundredths of 1 per cent; for Idaho, one-tenth of 1 per cent. In other words, the cutting is far within the growth capacity of the forests.

Reforesting of denuded land in the National Forests was pressed as vigorously as possible. Because of the expense and the great difficulties involved progress in the initial stages is slow. The watersheds which are receiving first attention are those most in need of immediate improvement for the benefit of municipal supplies or communities dependent on irrigation. About 450 acres were planted with young trees and 1,250 acres were sown with tree seed. The nurseries contained, at the end of the calendar year 1909, 7 million seedlings and transplants.

The National Forest range supported nearly 1 million more head of stock than last year—an increase greater than that made in the area under grazing control; in other words, the carrying capacity of the range under regulated grazing has advanced.

Under the cooperative agreement entered into with the Department of the Interior for the management of forests in Indian reservations, work was carried on in Washington, Oregon, California, Idaho, Montana, South Dakota, Arizona, Minnesota, Wisconsin, and North Carolina. This agreement provided that the Forest Service should take charge of all timber sales, supervise all logging, and protect against fire all forests on Indian reservations. It also provided that the Forest Service should prepare and apply plans for handling, as productive forests, all the timbered lands for which this was found to be the best permanent use. The ends sought were (1) to secure for the Indians the full value of all timber sold and (2) to safeguard and improve the forests themselves. All expenses incident to the conduct of the work were to be borne by the Indian Office, which also prescribed the policies to be followed in the employment of Indian labor, and in all other matters affecting the welfare of the Indians. Responsibility for all work in the woods was assumed by the Forest Service.

During the year 190 million feet of timber, worth over $1,000,000, was logged under the supervision of the Forest Service. Plans were prepared for the utilization by sale of much additional fire-killed and wind-thrown timber. Regulations were put into effect to prevent unnecessary waste and harm to the forests when Indians cut timber for their own use. The methods of logging on various operations in progress when the agreement was made were radically modified, to the great advantage of the Indians. Fire protection was effectively maintained in the face of unusually threatening conditions and with the saving of an immense amount of timber from destruction. The extension of the work contemplated by the agreement to all Indian reservation timber was prevented by the inability of the Indian Office to make the necessary allotment of funds.

Shortly after the close of the fiscal year this cooperative agreement was terminated.

Timbered portions of reservations were examined, plans of management prepared, or timber sales supervised for the War Department, the Navy Department, and the Department of Commerce and Labor.

Cooperation in the study of state forest problems of various kinds was conducted with New Hampshire, Kentucky, Alabama, Florida, Michigan, Oklahoma, Utah, and the Illinois state laboratory of natural history.

Forest studies in cooperation with private owners were made in 26 States, and by the Service independently in 16 States, in addition to the studies conducted on National Forests. Cooperative experiments in nursery and planting work were also made, chiefly in cooperation with state experiment stations and state foresters.

In the field of forest products important studies of present supplies, uses, markets, and prices of timber, of the natural qualities of wood and of methods of handling and treating it to secure the best service, and of wood waste and its possible reduction, were continued and developed along practical lines.

BUREAU OF CHEMISTRY.

In addition to its work in connection with food and drug inspection, the Bureau of Chemistry is engaged in numerous studies of a chemical nature, all in some way associated with the advancement of agricultural interests. Some of these have progressed so far that tangible results could be announced during the year.

Studies of sweet corn have shown that it makes little difference whether the corn is grown in a northern or a southern latitude, so far as the sugar content is concerned, although the northern-grown "roasting ears" may have greater tenderness and a longer season. Methods have been devised by which the corn after plucking may be kept a day or longer at a low temperature and retain its flavor. These results give promise that the city consumer may hereafter have green corn almost as sweet and tender as if taken directly from his own garden.

Experiments with wheat show that soil and climate have a very important influence—perhaps a predominant influence—upon the chemical composition. For instance, seed of the Crimean variety of wheat grown in Kansas contained 20 per cent of protein, but when this seed was sown in California it yielded a crop with only 11 per cent of protein. The results of these experiments indicate that when crops are to be improved by selection it is essential that the selecting process be carried on in the locality in which the crops are to be grown.

With the view of securing information which may lead to the improvement of American wines, 110 samples of such wines were tested and analyzed, the various steps in the process of wine making as commercially practiced were observed at Sandusky, Ohio, representative samples of the juices of all the important varieties of grapes grown in that region were analyzed, and wine made by the Bureau from the leading varieties, under the most carefully controlled conditions, is now under observation. It is expected that these studies will make an important contribution to our knowledge of correct processes of wine making under American conditions.

The Bureau of Chemistry collaborated with the inspection laboratories of several cities in an effort to improve the quality of the milk furnished to the city consumers. It was found that adulteration of fresh milk was much more prevalent than had been thought. In one city the instances of watering, under the guise of ice placed in the cans to cool the milk, were surprisingly numerous. Several convictions resulted, and it is believed that the local authorities have been materially assisted in their work.

Many manufacturers have complained that the Department's standard of 28 per cent for total solids in evaporated milk is too high. This led to observations of the process of evaporation at several factories and the examination of more than 100 samples in order to test the question. This study is not yet completed.

It can now be stated that the quality of the drugs imported into this country has materially improved. When the work on drugs was begun it was rare that imported belladonna roots and leaves, for instance, were not found to be adulterated with some cheaper substances; but at present it is just as rare to find these drugs adulterated. There is still some importation of drugs which fall below the recognized standard, however. In interstate commerce, also, a certain proportion of adulterated drugs is still to be looked for. One sample supposed to be kamala examined during the year was found to be nothing but red sand, while powdered conium and ipecac have been found adulterated with powdered olive stones.

The quality of the chemical reagents furnished the Department has materially improved during the year, owing to the rigid examination which they now undergo upon their delivery. Certain reagents, of which ethyl acetate and acetic acid are examples, are now furnished of a high grade, whereas manufacturers formerly declared that they could not be so furnished.

At the request of the Post-Office Department the Bureau of Chemistry analyzed 15 medicinal agents represented as cures for various maladies and sent or prescribed through the mails in violation of the postal laws.

Since the passage of the Food and Drugs Act the "prescription scheme" has arisen. Under this plan of selling proprietary medicines, a prescription is sent through the mails. The prescription will contain several well-known medicinal agents, but also a coined name of some unknown product. In order to fill the prescription, the recipient must purchase the agent sold under the coined name. Analyses of these products have shown that they usually consist of the cheapest and commonest of ingredients, although the advertisements would lead one to believe that the product with the coined name is new or rare, and that the remedies are panaceas for various diseases. Such remedies are plainly fraudulent, since they have no curative properties for the diseases for which they are recommended.

An investigation of the effects of acetanilid, antipyrin, and phenacetin, drugs commonly used in headache remedies of the present day, showed that the indiscriminate use of these drugs—or remedies containing them—without the advice of a physician, frequently produces poisoning, a drug habit, or, in some cases, death.

Tests of papers to the number of 1,559 were made during the year for the Government Printing Office, and 2,528 examinations of papers and leathers were made for the Post-Office Department. Besides these, 2,606 analyses were made of samples of supplies purchased on contract for the various Departments of the Government, and 5,511 pieces of apparatus were examined.

The study of paper-making materials has not yet revealed anything which can compete, under usual conditions, with rags, wood, straw, and the commonly used fibers in quality or in cost of papers made.

A study of the spirits of turpentine found on the market showed that about 20 per cent of the samples collected were adulterated, and the average amount of adulterants present was 6.5 per cent.

In experiments on the refining of wood turpentine by steam and by destructive distillation it was found that a wood turpentine of superior quality can be thus produced, although it has not been possible to secure a sharp separation of oils having a given boiling point. These studies are being continued.

In the fall of 1908 an experimental school was organized for instruction in the art of making denatured alcohol. The school was well attended. A series of lectures was given, covering all phases of the subject and extending over a period of nearly two months. Practical demonstrations of distilling processes were given in connection with the operation of a small but well-appointed distillery set up on the premises of the Bureau of Chemistry, the chief purpose of which was experimentation in the making of denatured alcohol from waste materials of the farm. The materials tested included molasses, apples, small grain, corn, watermelons, and potatoes. Definite conclusions have not yet been reached. It seems clear, however, that the profitable utilization of waste materials of the farm will call for especial skill, and that the manufacture of denatured alcohol in a small way in this country will require the instruction of a large number of young men in the art of fermentation and distillation.

The study of deterioration of foods in storage has been continued and has been extended to include storage at ordinary temperatures as well as cold storage. The analytical methods have been perfected, and the work has been carried on with careful attention to a greater variety of detail than during earlier years.

In the study of cold-stored chickens the Department is finding cordial cooperation among all classes who are interested in the handling of poultry. In the further investigation of this subject it is planned to make a complete study of all the conditions to which a chicken may be subjected from the time it is killed until it reaches the consumer. Such a study should result in valuable additions to our knowledge of the decomposition of flesh as influenced by commercial methods, and should also prove valuable to consumers since it must result in improved food supplies.

BUREAU OF SOILS.

THE SOIL SURVEY.

During the year the soil survey was concerned in the mapping of the soils of forty-five different areas in twenty different States. As the result of detailed surveys there was completed the mapping of 24,436 square miles of area, the maps to be published on a scale of 1 inch to the mile, upon which scale an area of 10 acres has been considered the unit. In addition to this, reconnoissance surveys of large areas were completed in the Great Plains country. Westward of the ninety-ninth meridian to the foothills of the Rocky Mountains, where the soils generally are level or gently rolling, they are uniform over rather large areas, and the climatic conditions are such that, except under conditions favorable for irrigation, general and "extensive" farming must prevail for a time. It is estimated that this area contains approximately 500,000 square miles. In this region, extending from Canada on the north to Mexico on the south, I have directed that the soil survey be so made that the maps may be published on a scale of 6 miles to the inch, which is adequate to cover the needs of that country for many years to come. On this scale all of western North Dakota was surveyed and the report and map were prepared for publication. An area of 16,000 square miles in southwestern Texas was also completed, and the report and map on this area are about ready for publication. An area of about 10,000 square miles has been completed in the Panhandle of Texas, but as it is anticipated that the whole Panhandle region can be completed during the coming fall and spring the report upon this area is temporarily withheld, awaiting the completion of the survey of the entire region. The survey of the western half of South Dakota has been completed and the force will be moved into southern Texas. A total area of 76,180 square miles was surveyed in the Great Plains region, and it is expected that by the end of the present fiscal year western Nebraska, western Kansas, and the whole of the Panhandle of Texas will be completed, making almost a continuous strip from Canada to Mexico. This will leave the western half of the area to be completed, including eastern Montana, eastern Wyoming, eastern Colorado, eastern New Mexico, and western Texas.

Reconnoissance survey work is also being carried on in the Appalachian region, and by the end of the present field season practically all of western Pennsylvania will be mapped on a scale of 6 miles to the inch. This same scale of work is also being used in the cut-over pine lands of Washington, giving excellent results for large areas of fairly uniform soils in a region relatively thinly settled, and at a very much lower cost per square mile than for the more detailed work required in the Eastern States, in the irrigated areas, or on the California coast. Altogether the soil survey has mapped during the fiscal year an area of 100,616 square miles, at a total cost of about $145,000, including the field and office expenses. This makes in all for the soil survey 257,694 square miles which have been surveyed and mapped since the beginning of the work in 1899.

General interest in the soil survey work has been rapidly increasing. More and more use is being made of the data in the agricultural development of the country. The precise knowledge of the soils and conditions prevailing in different parts of the country is being utilized by farmers and prospective settlers, and it is proving to be one of the great educational means for the gradual development of more intelligent and more systematic methods and agricultural practices.

SOIL FERTILITY.

A great and fundamental problem which has confronted our people, as it has the people of the world, is the question of the permanency of soil fertility. Of late years, particularly, the idea has prevailed that the soils of various parts of the United States are wearing out through loss of mineral plant food, and that a serious condition is thus presented for the future of our people. So important and fundamental is this problem for the welfare of our people that I directed a thorough examination to be made of the whole subject, and an exhaustive report has been issued, from which certain important conclusions can be given in a few words.

It has been found from the records kept by our own Department that, on the average, crop yields per acre have shown a decided tendency to increase during a period of forty years, and that there is no evidence of general decrease over large areas or in any particular State, as is popularly supposed. This indicates, undoubtedly, that on the average our people are farming more intelligently and therefore more successfully, and that we are, through these more intelligent methods, winning gradually larger returns from the soil.

It has been held, however, by some writers that even if the yields are increasing, the element of danger is that the larger crops remove larger amounts of plant food from the soils and bring nearer the time when the soils will eventually wear out. To meet this argument it has been necessary to extend the investigations into older countries, and the records of Europe have been searched for information in regard to the past history of these older countries that can be taken as a safe guide for the future of the newer soils of the United States. These records indicate that in the middle of the sixteenth century, or, roughly speaking, three to four hundred years ago, the soils of central and northern Europe were producing on the average about as much wheat as the soils of the United States are producing at the present time. These European soils have been occupied for agricultural purposes for at least a thousand years, during most of which period the country was more densely populated than the United States is at the present time. So far as records are obtainable, they indicate that as a result of increasing population and more intensive and more intelligent methods of soil control, and in spite of their longer occupation, the average yield per acre has increased, until in the case of northern Europe the soils are now producing about two or two and one-half times as much per acre as the newer soils of the United States are producing.

In addition to this evidence of actual crop yields per acre, an exhaustive investigation has been made of all the chemical analyses which have been made of soils for the last eighteen years in certain countries of northern Europe in which crop yields have been increasing, and likewise of the soils of the United States, including the older soils of the Eastern States and the newer soils of the Western States. The results of these analyses, published side by side, show no significant difference in chemical composition between the older soils of Europe and the newer soils of the United States. Microscopical examinations of the soils fail to show that the longer occupation of the soils of Europe has changed noticeably the mineralogical character of the soils. It is reasonable to infer from the work that has been done that within historic times the occupation of the soils for agricultural purposes has failed to noticeably change the mineral character of the soil material upon which the future life of the nation must ultimately depend. The reasons for this and the laws of nature which permit the soil thus to be continuously occupied and used for mankind as freely as the air are complicated and difficult to understand, and offer a profitable field of research for our agricultural colleges and experiment stations.

While this satisfactory solution of this main question is hopeful for the nation, nevertheless individual farmers fail and individual farms run down through neglect, lack of intelligent cultivation, and lack of knowledge as to soil adaptations and methods of control. So far as can be observed at the present time, cases of failure on the farm are due to individual neglect or misjudgment. Such injury as has resulted to the soil in such cases may be remedied by change of ownership or by more intelligent methods of control, and is therefore not fundamentally due to the soil itself, but to the people who have worked the soil. This is a condition which can be improved either through force of necessity, as it has been in the case of Europe in the past, with increasing population and greater necessities, or through education and force of intellect, utilizing the advance knowledge which now prevails alike in Europe and in America.

The first lesson that our people must learn—one which is taught by the operations of the soil survey—is that we have a great variety of soil types (700 different types of soil having already been encountered in the area that has been surveyed), and each one of these soil types has its own peculiarities, its own characteristics, and its own peculiar adaptation to crops, rotation schemes, and methods of soil control. This is the great fundamental fact which our farmers must understand: The first step in agricultural development is the knowledge of the particular soil characteristic of the farm.

The idea has prevailed in the past that through the use of commercial fertilizers and intelligent control all soils can be made to produce at will any crop that it is desired to grow. From a scientific standpoint this may be possible, but it can not be done at a profit. There are soils that can not be adapted commercially to wheat production, there are soils that can not be adapted commercially to fruit culture, and there are soils that can not be adapted commercially to any of our staple crops, and should remain as forest soils. The highest development of agricultural production will result from the adaptation of each type of soil to a particular line of crops, bearing in mind at all times the market requirements and the transportation facilities.

ABANDONED FARMS.

The United States has been developing for agricultural purposes an area as large as the whole of Europe, while its population is but little larger than that of any one of several European countries. So much has fashion and sentiment had to do with this agricultural development that many of the lands, particularly in the Eastern States, have been practically abandoned, so far as profitable agricultural use is concerned, by the shifting and moving of our agricultural population into new regions in which lands are purported to be cheaper and in which the advertised inducements have been proportionately large. With the rapid extension, also, of our industrial life and the opportunities offered in the past in business and in the professions, the cities have called upon the country for clear brains and vigorous bodies to such an extent that large areas have become so depopulated of active and vigorous minds and bodies that the stock is insufficient to repeople the country districts. The result has been that some of the most fertile lands in our Eastern States, some of the most fertile lands of the world, have been left in a condition of practical if not actual abandonment, and the price of provisions has increased for the simple reason that there are not enough people to actually work the soils and to raise the crops necessary to feed the nonproducing population of the cities.

The great problem which faces American agriculture to-day is the problem of the proper utilization of our soils and the development of our agricultural interests in spite of and in face of the allurements of the cities and the commercial and industrial avocations. It has now become as serious a problem to settle up our Eastern States as it has been in the past to settle the West. The first problem of all is to devise means of resettling the lands which have in recent years been neglected through the mistaken idea that they have become exhausted, but which, it is now clearly apparent, can be brought back to an increasing production through a change in farm management and the infusion of new and active blood into the rural communities.

BUREAU OF ENTOMOLOGY.

Several important practical results have been reached by the Bureau of Entomology in the course of the year, and excellent progress has been made in all of its investigations. Certain new lines of work have also been begun.

GIPSY MOTH.

The gipsy moth has been held within the bounds established a year ago except in the State of New Hampshire. Here a number of localities have been discovered to the north of the old infested region. It is not probable, however, that the spread of the insect to these localities has been recent, but rather that they are simply points at which it has not previously been discovered. Cooperation with the state officials of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut has been continued. The force of the Bureau has continued cutting underbrush and removing deadwood and undesirable trees to a distance of 100 feet from the roadway on either side of the roads leading through the worst infested woodlands. More than 300 miles of roadway have been cleared in this manner, making it impossible for gipsy moth caterpillars to drop from trees along the roads upon passing vehicles. These strips have also been sprayed with arsenicals, and the trees have been banded with sticky paper, so as to prevent the ascending of caterpillars crawling from underbrush. The improvement in the infested territory in Massachusetts, Maine, Connecticut, and Rhode Island has been marked except in woodlands proper, and much experimental work has been carried on which indicates that eventually it may be possible to apply remedial measures in such localities.

An important step in preventing the further spread of the gipsy moth has been taken in cooperation with the different railroad corporations operating within the infested territory. Under a regulation put into effect by the railroads on July 1, 1909, shippers of lumber, cordwood, fence posts, railroad ties, and other forest products are required to present a certificate of inspection before the railroads accept the shipments. Shippers now request inspection from the Department's agents. It is thought that by this method the danger of spread in this way will be minimized, and this method of spread is considered as secondary only to the carriage of caterpillars dropping from roadside trees on passing vehicles.

IMPORTATIONS AND EXPORTATIONS OF USEFUL INSECTS.

In cooperation with the State of Massachusetts the extensive experiment in the introduction of foreign parasites of the gipsy moth and the brown-tail moth has been carried on as in previous years. An American agent was sent to Russia, the Chief of the Bureau of Entomology visited different European countries, and the different European governments as well as the government of Japan have cooperated through their official experts, while several private entomologists have also cooperated in a hearty manner. The result has been that more parasite material was received during the year than ever before. The best results have come from France and from Japan.

During the year twelve species of introduced parasites and predatory insects have been recovered from the field, indicating a reasonably certain establishment in this country. The close of the year finds twice as many species of introduced parasites in the field as were present last year. Many of them have scattered over extensive areas, one species having been found over an area of 500 square miles. It is hoped, by the continuance of the same and improved methods, that this number will be increased during the present year.

News has been received from Italy that American parasites of the mulberry scale insect sent to that country in return for similar favors to this Government have established themselves in certain regions in such numbers that the danger from the scale is considered passed. Certain ladybird beetles have been sent by the Department to Malaga, Spain, for the purpose of preying upon a species of mealy bug. Parasites of scale insects have been sent to Peru. A species of tick parasite occurring upon the dog tick in Texas has been sent to South Africa. The exportation of bumblebees to the Philippine Islands for the purpose of fertilizing clover is reported to have been measurably successful, and American bumblebees have been found in certain regions in the Philippines during the year.

MEXICAN COTTON BOLL WEEVIL.

The work conducted by the Department against the Mexican cotton boll weevil has been followed up in much the same way as in previous years. The crop of 1908 was damaged to the extent of about $30,000,000, the loss in Texas being light compared with that in Louisiana and a small portion of the State of Mississippi that has been invaded. The lesser loss in Texas, however, was due to abnormal weather conditions. The great loss in Louisiana is a verification of the prediction made for several years, and it indicates the importance of means of control adapted to such conditions as are found in Louisiana and other States that will soon be invaded by the weevil. The insect enemies of the boll weevil have come to be of great importance, and examinations made to determine the mortality rate due to this cause have indicated that in one case 77 per cent of the boll weevils in a field in Louisiana were being destroyed by their insect enemies, and at various points in Texas 21 to 48 per cent were killed in the same way. It is evident that the extent of control secured in this way is greater than that by any artificial means. It has been found feasible to make certain changes in the planting and cultivating systems that will greatly facilitate the work of the natural enemies of the weevil. Experiments in the introduction of parasites from one region to another have been measurably successful. Methods of planting, varieties planted, spacing, and methods of cultivation and harvesting all have a bearing upon control by parasites. Each one of these features has been investigated. The subject is an extremely complicated one, and will require additional work for several years. The chain drag mentioned in my last Report has been used with success, and its use has been found to have an important cultural effect upon the crop, in addition to its usefulness as a weevil destroyer. Special studies have been made in the Mississippi Delta, where conditions differ to a considerable degree from those in any other region invaded by the weevil. The heavy precipitation, presence of heavy timber, mild winters, and other features combine to make the boll-weevil problem more serious than it has been elsewhere, and especial work has been carried on for the purpose of ascertaining any changes in the life history of the weevil due to these differing conditions.

INSECTS DAMAGING FORESTS.

A study has been made of the white-pine twig blight in New Hampshire to determine the relation of insects to the several forms of blight. A study has been made of the injuries by insects to storm-felled pine timber in the South, in which it has been shown that a large percentage of this loss can be prevented. Investigations of insect depredations in private forests of northern California have been carried on, in which much valuable information was accumulated on which special recommendations to the owners were based, and an investigation has also been made of the relation between injury by sulphur fumes in smelting centers to the timber on private lands near by and subsequent injury by insects. Investigations and practical demonstration work have been continued in regard to the insect damage to hardwood products with gratifying progress. Co-operation in control demonstrations with private forest owners, state forests, and National Forests has been begun in several instances, and this line opens up promising possibilities. The practicability of controlling the Black Hills beetle, the most destructive enemy of pine timber in the central Rocky Mountain region, has been demonstrated during the year on a large private estate and the adjoining Pike National Forest in Colorado. It has been shown that this control can be exercised not only with economy, but actually at a profit above the cost.

INSECTS DAMAGING DECIDUOUS FRUITS.

PEAR THRIPS.

The results from the work on the pear thrips in California during the fiscal year were admirable, and the investigation has been eminently successful. Full studies of the life history of the insect were made, extensive experiments in all directions were carried on, and, with a basis of accurate life history knowledge, the substantial control of the insect has been accomplished. Early experiments in deep plowing of the soil during the summer to destroy the larvæ of the thrips, which at this period are all beneath the surface of the ground, gave practically negative results, since the larvæ are active at this period and are quickly able to construct new cells in which they live undisturbed. In the fall, however, it was discovered that deep plowing and cross plowing, with harrowing after the first rains, was very effective. At this time the insects are mainly in the helpless pupal stage, and are very susceptible to any disturbance. In two orchards in the Santa Clara Valley where this method was thoroughly tried there were killed, respectively, 70 and 73 per cent of the insects. This process also puts the soil in better condition to retain the water from the winter rains and brings about a more vigorous condition of the trees. More than 70 per cent of the insects being destroyed by this process, it has been found that from 90 to 97 per cent of the remainder may be killed by proper spraying, under high pressure, in a downward direction, with a combination spray of a diluted tobacco extract and distillate oil emulsion. Demonstration work resulted in the protection of the blossoms and the production of a full crop in orchards in which for some years practically the whole crop had been destroyed. The problem, therefore, is solved, and with a few additional demonstrations the handling of the pear thrips can safely be left to the orchardists.

CRANBERRY INSECTS.

The work on cranberry insects has been continued and enlarged. Owing to conditions which render flooding of bogs of questionable safety, especially in midsummer, in Wisconsin, attention has been largely devoted to sprays. Demonstration experiments in spraying have been carried on in different portions of the cranberry marshes in the Cranmoor district of Wisconsin, and have shown uniformly good results. Combination sprays of Bordeaux mixture and arsenate of lead have reduced injury by the fruit worm from 60 per cent down to 14 per cent, which means an equivalent in money gain of about $86 per acre.

OTHER INSECTS DAMAGING DECIDUOUS FRUITS.

Extensive tests in different parts of the country have been made with the one-spray method advocated in the Northwest against the codling moth, and demonstration sprayings for the codling moth and apple diseases have been carried on in cooperation between the Bureau of Entomology and the Bureau of Plant Industry in several States. Further observations have been made concerning the work of the codling moth in pears, a difference in treatment between pears and apples seemingly being demanded in California. Work on the grape root worm has been carried on, and it has been found to be practicable to protect young vineyards from further injury by a system of spraying and cultivation, and also, by a schedule of treatment including pruning, cultivation, spraying, and the use of fertilizers, to restore to excellent bearing condition old vineyards so badly injured by the root worm as to have become unprofitable. Studies have been made of the question of arsenic accumulations in soils, in sprayed woodlands, orchards, and vineyards, and much work has been done on investigations of orchard insecticides.

FIELD CROP INSECTS.

The work on field crop insects has been largely devoted to the green bug, the joint worms, and the Hessian fly.

THE SO-CALLED "GREEN BUG."

This insect was practically absent from most of its range until the early fall of 1908, on account of its great reduction in numbers by natural enemies, but studies were continued in which it was found that this insect has twenty-five native food plants and a number of parasites hitherto unknown. Moreover, a knowledge has been gained of just when and under what conditions the parasites of the "green bug" can be depended upon to prevent an invasion, and what the farmer must do himself to reduce the severity of the invasion. Some local outbreaks occurred in the spring of 1909, and investigations have shown that the farmer can do much to protect himself by preventing the growth of volunteer grain in fields intended for fall wheat or oats, and by delaying the sowing of these crops as late in the fall as possible, the object being to prevent the pest from becoming established in the fields until as late a date in the fall as possible.

JOINT WORMS.

Careful studies in the Northwest of the damage by the wheat straw worm indicate that its injuries can be prevented by cultural methods, namely, by rotation of crops, clean, early summer fallow, and the temporary abandoning of spring-wheat culture in the infested regions. Studies of the true joint worm in Ohio, Indiana, and Illinois, where a serious outbreak has occurred, indicate that late seeding of wheat, in connection with rotation of crops, tends to reduce its injuries.

HESSIAN FLY.

The wheat-sowing experiments started in Kansas in 1907 have resulted in the gaining of information whereby a threatened outbreak in 1909 was practically avoided, owing to a campaign of late sowing based on these results, instituted and followed up by the state experiment station, the agricultural press, and millers, grain dealers, and, in one instance, by a church organization. It is estimated that the wheat-sowing experiments in Kansas resulted this year in the saving of $500,000 or more.

INSECTS INJURIOUS TO VEGETABLE CROPS.

Work on truck crop insects has been carried on on a larger scale than ever before in tidewater Virginia, in south Texas, and in Florida, and much additional practical information concerning insects of this class has been gained. Work has also been done upon sugar-beet insects in California and other portions of the West.

INSECTS AFFECTING CITRUS FRUITS.

WHITE FLY.

The investigation of the white fly in Florida has been continued with the purpose in view of placing every practicable manner of control on the best possible basis. During the fiscal year life-history studies and fumigation experiments were practically concluded, and experiments with contact insecticides were taken up again, after having been discontinued temporarily to allow for the conclusion of the fumigation experiments. Experiments with fungous parasites of the white fly were continued with much progress, and the study of trap foods has been taken up. The discovery of another injurious species of white fly of citrus fruits in Florida has made necessary comparative studies of life history, economic importance, and control, although this second species is fortunately more easily controlled than the first. Fumigation experiments were conducted on a large scale in cooperation with several orange growers, and a number of practical points in fumigation have been brought out.

HYDROCYANIC-ACID GAS FUMIGATION IN CALIFORNIA.

This work has been continued along strictly economic lines, with the primary object of increasing the efficiency of fumigation as well as of reducing its cost. The results have already practically revolutionized the old wasteful procedure, which possessed none of the elements of uniformity. The entire practice of fumigation has been rapidly standardized. Before the next season closes it is prophesied that practically all fumigating outfits in southern California will be working under the standard system devised by the Bureau of Entomology, and it seems probable that, after the general adoption of the system, a single treatment every second year will accomplish the same results as an annual treatment, thus giving an annual saving of from 30 to 50 per cent of the present cost.

ORANGE THRIPS.

A new insect enemy of the orange has become prominent in portions of California, especially in an important and rapidly developing orange district. This insect punctures the rind of the newly set fruit and of the older fruit, bringing about a scabby or russety condition, largely reducing its value. Tender foliage is also severely injured, especially the foliage of nursery stock. This is a new investigation and was begun only in April, 1909, so that it is too early as yet to announce results.

INSECTS WHICH CARRY DISEASE TO MAN AND DOMESTIC ANIMALS.

Work on mosquitoes has been carried on actively, as during the last ten years, and yet during the year new points of practical value have been brought out. It has been discovered that a large part of the mosquito supply of otherwise well-conditioned portions of large cities is sewer-bred, and that malaria-bearing mosquitoes in dry summers will breed in the sewer traps, making it extremely important for the health officials to treat all sewer traps with kerosene or some other "culicide." Work on the house fly has been continued, and a bulletin on this insect and other disease-bearing insects has been published, which has attracted still further attention to this unnecessarily dangerous pest. The crusade against the house fly, indicated in my last annual report, has become during the fiscal year of almost a national character. So many boards of health have taken it up, and so many civic organizations have turned their attention to this subject, that the whole country may be fairly said to have been aroused.

TEXAS CATTLE TICK AND OTHER TICKS.

Observations on the habits and life history of the Texas cattle tick have been carried on in continuation of the work under way during the preceding year. Special attention was devoted to the determination of the points in life history that are of importance in the various systems of control depending upon the transference of cattle from one pasture to another. This work is of great importance to ranchmen in the area that will not be reached for some time in the plan of total eradication now being so successfully conducted by the Bureau of Animal Industry. Demonstration experiments in cooperation with ranchmen have been successfully carried out. Tests of the possibility of the carriage of Texas fever to other animals have been made, and studies have been made of other ticks which may be agents in the dissemination of diseases of other domestic animals. A considerable amount of work was also done on the tick which transmits the so-called spotted fever of human beings.

INSECTS INJURIOUS TO STORED PRODUCTS.

Several insects of this class have attracted much attention during the year, and investigations begun in 1908, at the request of many milling companies in Kansas, Oklahoma, Missouri, and Texas, and of steamship owners and operators in Texas and Louisiana, have been continued. Special attention has been given to the flour beetles and to the important question of determining the place or places at which export flour from the different States mentioned becomes infested, whether chiefly at the mills, or in Galveston, or at New Orleans, or on the cars, steamships, or on wagons used in carting material from the mills to the carrier. There is no doubt that infestation occurs at all of these points, but it is feared that in some cases primary infestation begins at the milling establishments, although some of the mills which have been investigated are kept scrupulously neat and are thoroughly fumigated at least twice yearly. More attention has been paid to the Mediterranean flour moth than to any other insect of this class. This seems to be the most serious mill pest in the world. Investigations by the Bureau of Entomology indicate that fumigation of milling establishments with hydrocyanic-acid gas is the most perfect remedy. Bisulphid of carbon is less effective, as a rule, and the same may be said of sulphur dioxid.

INSPECTION WORK.

As in previous years, the plant material introduced by the Bureau of Plant Industry has been inspected before shipment throughout the country. In January, 1909, it was discovered that winter nests of the brown-tail moth were occurring extensively on shipments of apple and pear seedlings coming to the United States from portions of France. Investigations showed that these winter nests had been found upon seedlings so imported in many different parts of the country. Warning letters were sent to different state entomologists, and the customs officials of the different ports of entry were directed by the Secretary of the Treasury to inform the United States Department of Agriculture immediately upon the arrival of any nursery stock from abroad, and the principal railroads were notified of the danger of carrying such plants. As a result, not only the customs officials but also the railroads promptly notified the Bureau of Entomology of the ultimate addresses of all cases of plants received, and in this way the Bureau was enabled to notify state inspectors and other competent persons, and to employ inspectors in the States not provided with inspection service at the points of ultimate destination, and to secure inspection and the destruction of infested plants. Notifications of 800 shipments, divided among 35 different States, were sent out, and it is probable that all, or practically all, of the imported nests were destroyed.

BEE CULTURE.

The work on bee diseases has been continued. Samples have been received from many parts of the country, and the information gained from this work has been of great value, especially in the way of giving information to state legislatures which are contemplating the passage of laws providing for a much-needed inspection of apiaries. Notifications of the nature of bee diseases, especially in cases of new outbreaks, have been of much value in preventing their further spread. New studies have been made of the structure and development of bees, of their activity, of the status of bee keeping, and, in cooperation with the Bureau of Chemistry, the Bureau of Entomology has begun work in wax analysis.

OTHER INVESTIGATIONS OF INSECTS.

The work on tobacco insects has been continued with practical results of value. It is hoped that this work can largely be completed during the coming year. Studies have been made of insects affecting the pecan, as well as of many kinds of insects injurious to shade trees and ornamental plants. A large amount of work has been done on scale insects, and the Bureau of Entomology is making an effort to inform itself concerning the scale insects of the entire world, since these insects are especially liable to introduction from one part of the world to another.

BUREAU OF BIOLOGICAL SURVEY.

The essential basis of the work of the Biological Survey is the study of American birds and mammals in their economic relations. Many of our mammals and a few of our birds are seriously destructive, so that accurate knowledge of the food and habits of such pests and of effective means for reducing their numbers and preventing their ravages is becoming more and more necessary to profitable agriculture and stock raising. Almost as important is a widespread knowledge of the part our useful birds and mammals play in aiding the farmer; for it is an undoubted fact that, taking the country as a whole, the number of our game and insectivorous birds and of our useful mammals may be augmented with great advantage to the farmer.

The constantly increasing number of sportsmen and the growing demand for game for food partly explain the relative scarcity of game birds and mammals, while the destruction of forests, the encroachment of civilization on the homes of wild birds, and their destruction by predaceous mammals, especially cats, and for ornamental purposes, go far to explain the diminished number of many kinds of useful birds. The public must have a thorough understanding of the important part birds and certain animals play in checking the increase and spread of noxious insects before present conditions can be improved. Much may be done through the education of the young, especially the pupils in our public schools. By the distribution of publications containing the essential facts in regard to the habits and food of birds, the Biological Survey seeks to aid materially in this educational work. It is gratifying to be able to state that the demand for this kind of literature on the part of educators is constantly increasing. Nor are evidences wanting that a fuller comprehension of the services rendered to agriculture by birds and mammals and of the means necessary to protect and encourage them is already bearing fruit.

HOUSE RATS.

Although from very remote times rats have been recognized as pests, it is only recently that their extermination has assumed international importance. Investigations in many parts of the world reveal the fact that everywhere the losses occasioned by these mischievous rodents are enormous. House rats appear to be constantly increasing, and the discovery that they convey the germs of disease, especially plague, from place to place and from port to port, renders their destruction highly important.

While in several countries, notably England, Denmark, and parts of the United States, vigorous efforts have been made to exterminate rats, or to materially lessen their numbers, the results thus far attained are not reassuring. The rat is exceedingly wary and difficult to destroy, and is very prolific. Except where funds are practically unlimited, and cooperation possible on an extensive scale, the check to increase is only temporary, and in a few months after efforts have relaxed the rodents are as numerous as ever. The true remedy for the rat pest therefore lies in prevention rather than cure. The rat pest has its origin chiefly in cities, especially seaports, spreading thence to smaller towns and to the country. Hence it may be most effectively dealt with through municipal ordinances. As a measure of first importance the rat-proofing of all buildings within city limits should be rigidly enforced. Such ordinances when supplemented by the withholding of food from the rodents would go very far indeed toward finally abating the evil.

The present most important source of food supply for rats is garbage of various sorts, especially kitchen refuse. Immense numbers of these rodents are fed in the back yards and alleys of cities. The storage of household garbage in closed containers, which should be frequently and systematically emptied, is, therefore, an absolutely necessary supplementary measure, as also the protection of all sorts of forage, much of which is now loosely stored and easily accessible to rats.

If rats are denied harborage in dwellings, markets, stores, stables, and public buildings—the expense for which will be but a tithe of the loss they now cause, directly and indirectly—and if the present abundant food supply can be withheld, not only will their numbers be materially lessened, but the use of traps and poisons will be made vastly more effective than now.

The Biological Survey has continued experiments with various kinds of traps and baits, and also with poisons, and has published a useful bulletin on the subject, which may be had on application.

Requests are constantly received from all parts of the country for information as to the effectiveness of bacterial preparations for destroying rats. A number of these preparations have been put on the American market and widely advertised, and during the year tests have been made with several of them. When fresh and virulent, such preparations may usually be relied on to kill most of the rats which eat infected baits. The experiments fail to show, however, that the disease set up is in any sense contagious. On the contrary, it is confined to the individuals eating the baits. To some extent bacterial diseases may be communicated from dead rats to live ones, when rats that die from the disease are eaten by their comrades. Infection in this way, however, occurs on too small a scale to add materially to the effectiveness of the preparations. Thus more or less uncertain of action, limited in effectiveness, and costing so much as to make their use on a large scale practically prohibitive, none of the bacterial preparations thus far tested can be recommended to the public.

COOPERATION WITH THE PUBLIC HEALTH AND MARINE-HOSPITAL SERVICE.

A report on the conveyance of disease-producing bacteria by rats is now in course of preparation by the Marine Hospital Service, and in response to a request from the Surgeon-General the Biological Survey furnished three chapters on the following subjects: Natural History of the Rat; The Rat as an Economic Factor; Natural Enemies of the Rat. By request, also, a circular concerning the range and habits of the California ground squirrel, together with directions for poisoning the animals, was prepared by the Biological Survey and published by the Marine-Hospital Service.

CALIFORNIA GROUND SQUIRREL.

Among our more destructive rodents are the ground squirrels, which annually take a toll of $10,000,000 from the farmer. But the economic aspect of the case is quite overshadowed by the recent discovery by the Marine-Hospital Service that, like rats, ground squirrels in California serve as active agents in the distribution of plague. In one county 175 squirrels were found on examination to contain the germs of this dreaded disease, and they form probably only a small percentage of the whole number infected within the limits of a single county. Several cases of plague in man have developed as the result of bites from fleas harbored on squirrels. Thus the war against ground squirrels ceases to be merely of local interest and becomes of national moment. The extermination or reduction to comparatively insignificant numbers of the California ground squirrel, important before, is absolutely necessary if plague is to be stamped out in the United States, and only the most vigorous and persistent measures can be successful.

During the past year the Biological Survey has done much experimental work, on which it is still engaged, for the purpose of ascertaining cheap and effective methods of destroying these animals on a large scale. A formula for poisoning squirrels with barley and strychnine has been found which seems to meet the requirements better than any yet tried. The aim should be the complete extermination of ground squirrels over certain areas, especially those contiguous to seaports and other towns where the squirrels are likely to come in contact with plague-infested rats. The extermination of the animals over the whole of their present range in California, especially in the mountains, is quite impracticable under present conditions because of the great expense.

Even to diminish the number of ground squirrels in the farming districts at large to a point where the damage to crops may be disregarded will require the active cooperation of all the landowners, and this is difficult to secure, especially when large tracts of pasture land are under one holding. Such lands, if neglected, constitute nurseries from which adjacent lands which have been cleared of squirrels are soon repopulated, thus making the warfare a never-ending one. The suppression of the ground squirrel and other rodent pests in California, however, within a reasonable period should be greatly facilitated by the recently enacted state law declaring it the duty of landowners or lessors of rodent-infested lands to abate the evil, and on failure to do so conferring on boards of health the power to declare such places public nuisances.

The Biological Survey aims to aid in the suppression of the rodent plague in every way possible, and, so far as funds are available, will, when requested, send skilled assistants to infested localities to demonstrate the best methods of ridding land of squirrels and other rodents.

PRAIRIE DOGS.

Over large areas of the Plains regions and adjacent lower slopes of the mountains prairie dogs exist in great numbers, and wherever they occur in large colonies they are a pest, being very destructive to alfalfa, grain, and other crops. Even on lands devoted solely to pasturage they are a serious pest, since a few hundred of the little animals will consume as much grass as a cow. As their colonies often extend for miles and number hundreds of thousands, the quantity of grass devoured by their combined numbers is very great. An effective formula for poisoning prairie dogs was worked out some years ago by the Survey and is now being used by the Forest Service in ridding lands within and contiguous to the National Forests. Further investigations were begun last year, and are still being carried on, to discover a still more effective and cheaper formula for destroying the animals. It is easy at moderate cost to absolutely exterminate small isolated colonies, but when thousands of acres are to be freed from the pests the cost becomes an exceedingly important item.

LIME AND SULPHUR WASH AS A REMEDY FOR THE RABBIT PEST.

During the last year the lime and sulphur wash, which for a number of years has been employed to prevent damage to trees by the San Jose scale, was tried with great success in several localities as a protection for orchard trees against the attacks of rabbits. The remedy is cheap, and as a rule a single treatment in the fall appears to protect trees for the entire winter. Its more extensive use is recommended.

FIELD MICE.

No infestation of an agricultural area by field mice at all comparable in magnitude to the invasion of certain alfalfa districts of

Nevada in 1907–8 has occurred during the last year. These little rodents are, however, numerous and widespread over the United States, and the damage they do to garden, truck patch, orchard, and alfalfa field reaches annually a large aggregate in dollars and cents.

During the year many letters have been received from various parts of the country asking for measures of relief from these pests. In response, literature has been disseminated describing the best methods of reducing their numbers. It is urged that much may be done by systematically clearing up the neglected corners of fields and waste places along roads, by which means favorite hiding places of the mice are uncovered and the animals exposed to the attacks of their natural enemies, especially to birds of prey. Concerted action on the part of orchardists and farmers in cleaning up waste places and the putting out of grain poisoned with strychnine once or twice a year will so reduce the numbers of mice that all danger of mouse invasions on a large scale will be removed, and the damage by the pests reduced to comparative insignificance.

THE MUSKRAT.

Our fur-bearing animals are constantly diminishing in numbers, and the cost of furs is constantly increasing. Hence the importance of preserving the present supply and of increasing it in every way possible. Though muskrat fur is by no means of first-class quality, it serves many important purposes, and because of the availability of its fur, its abundance, and wide distribution, the muskrat ranks to-day among our most important fur bearers. Moreover, its food habits, adaptability to varied conditions, and fecundity are such that if proper closed seasons are established so as to permit the animal to breed undisturbed, the muskrat will yield a large annual crop of furs and yet maintain existence indefinitely, even in populous regions. It is believed, too, that on our Atlantic coast there are many tidal marshes of considerable extent which can be utilized as natural muskrat breeding grounds, with larger pecuniary returns than from any other industry. It is of interest to note that not only is the flesh of the muskrat edible, but when properly cooked it is well flavored and is relished even by epicures. During the winter months it finds ready sale in the markets of several of our larger Eastern cities under its own name or under that of marsh rabbit. During the past season the habits of the muskrat have been studied with reference to the value of its fur, the proper time for trapping, protective laws, and the suitability of its flesh for food, and a bulletin on the subject has been prepared for publication.

PROPAGATION OF BIG GAME.

The possibilities of growing venison for the market and of propagating deer, elk, and other large mammals within preserves has continued to receive the attention of the Survey. It is now well known that our native deer are well adapted to semidomestication, and their growing scarcity emphasizes the need of efforts to increase their numbers. The favorable reception by both farmers and sportsmen of a bulletin on Deer Farming attests the growing interest in this phase of game protection.

RELATION OF BIRDS TO FRUIT RAISING.

Birds frequent orchards chiefly for two reasons—to seek the insects that prey on fruit and fruit trees, and to feed on fruit. Fortunately the birds that are seriously destructive to fruit are few, while the greater number resort to orchards in the interests of the fruit grower. A careful study of California birds in relation to fruit raising has been in progress for several years, chiefly for the purpose of ascertaining the exact nature of the food of orchard birds and of informing orchardists how to discriminate between friends and foes, that they may encourage the one class and prevent or lessen losses from the other. The first part of a report on the subject was issued in 1907 and widely distributed throughout the State. The second and final part has been prepared and is now ready for the press. These investigations are being continued in Oregon and Washington, in both of which orcharding is an important and growing industry.

DUCKS AND SHORE BIRDS.

Investigations in regard to the food of wild ducks, begun several years ago, were continued, with particular reference to the transplanting from one part of the country to another of aquatic plants relished by waterfowl. By stocking the ponds and waterways, now practically untenanted by waterfowl, with wild rice, wild celery, and certain other favorite food it is believed that the number of ducks and geese may be materially increased, especially now that the strict enforcement of State game laws is generally recognized as essential to the continued existence of our waterfowl.

GEOGRAPHIC DISTRIBUTION OF WILD ANIMALS AND PLANTS.

It is well known that wild animals and plants are distributed in zones or belts which are characterized by certain peculiarities of temperature, rainfall, and exposure.

The general zone map of the United States on a small scale, with list of crops best adapted to the several zones, was issued in 1898 and has served a useful purpose, as shown by the extensive demand for it.

Work in relation to the life and crop zones of several of the States was pushed and much progress made during the year. The study of the life zones of California is now well advanced toward completion, especially in the southern part of the State. Field work in Colorado has been completed, and the results will soon be ready for publication. Field work in New Mexico also is finished, and a report will be prepared for publication as rapidly as possible. Considerable progress was made in field work in Arizona and Utah, but more remains to be done before reports can be completed. Reconnoissance work was carried on in Virginia, West Virginia, Tennessee, Georgia, Alabama, Mississippi, North Carolina, Kentucky, and Louisiana.

Knowledge of the geographic distribution and habits of animals formerly considered of little interest save to naturalists is fast growing in practical importance as the facts become known as to the true source and means of distribution of certain diseases. Some wild mammals, as rats and ground squirrels, are now known to be subject to some of the worst diseases which afflict man, and to spread them by harboring the insects which transmit them from host to host. Other species, now classed as harmless, may in future prove to be anything but harmless. The mapping of the ranges of wild animals, with special reference to species of economic consequence, is regarded as one of the most important duties of the Biological Survey, and this work is being prosecuted as rapidly as funds permit.

Revisionary technical studies of the rabbits and white-footed mice were completed during the year, and form the basis for more intelligent economic studies in these groups.

GAME PRESERVATION AND INTRODUCTION.

The preservation of our game and birds, though growing more difficult with increasing population, is making satisfactory progress. Each year brings a clearer understanding of the need for protection and for improvement in State laws. The hunting-license system, whereby a fund is provided for enforcing laws and restocking covers, has grown steadily in favor, and is now in operation in all but one or two States. Refuges where game may breed in security, to overflow into neighboring regions, are rapidly increasing in number, and the practice of caring for game in severe winter weather is spreading.

A similar awakening is manifest as regards nongame birds. The American farmer is well acquainted with the efficient service birds render in protecting his crops, and is strongly supporting the movement looking to the preservation of his winged allies. The millinery trade now makes little use of our native birds, but the destruction of plume birds in other parts of the world is enormous, and before long the United States will probably be asked to cooperate with other nations in its suppression.

IMPORTATION OF BIRDS AND MAMMALS.

Although the importations of birds and mammals (exclusive of ruminants and swine) aggregate nearly half a million, inspection is so thorough that the danger of the introduction of pests is practically eliminated. Two or three minor violations of the law came to light during the year and were promptly dealt with. The main interest in these importations attaches to the number of game birds imported. Nearly 30,000 gray partridges (commonly known as Hungarian partridges) were brought from Europe for liberation in the United States, chiefly in California, Connecticut, Illinois, Indiana, and Kansas. This is an advance of more than 400 per cent over last year's importation of these birds, which was more than 100 per cent above that of 1907. This remarkable increase indicates the growing tendency to apply the proceeds from hunting licenses to restocking covers. Only 1,200 pheasants were imported for this purpose—about as many as were brought in for aviaries.

Experiments in stocking preserves by means of eggs imported from Europe were continued, chiefly by one preserve owner in North Carolina, and 5,050 eggs of pheasants, partridges, and wild ducks were imported.

INTERSTATE COMMERCE IN GAME.

Even with the hearty support lent by sportsmen to modern game-protective measures, one of the most difficult problems in game preservation is the suppression of illegal traffic in game. A few cases of violation of the Lacey Act were taken up. Out of 9 reported to the Department, 4 resulted in conviction, 2 were settled out of court, and the remaining 3 are still pending. An important case, involving the shipment of 512 quail from Oklahoma to Chicago, which has been pending since 1905, was concluded, and the defendant was fined $400.

It has been extremely difficult to deal with these violations in the past, but two events of the year have removed some of the obstacles. The federal law has been greatly strengthened by the passage of the criminal code, and Illinois and Missouri, in both of which States there is considerable trade in game, which centers largely at Kansas City, St. Louis, and Chicago, have greatly improved their statutes, thus strengthening the federal law, which rests on state legislation. Hereafter it will be easier to deal with violations of the law, though supervisors at a few central points, for which no provision is at present made, are essential to full enforcement of the law.

BIRD RESERVATIONS.

The setting aside of government lands, of little or no agricultural value, for bird reservations (sanctuaries where colonies of birds may breed safely or take refuge during migration) has proved an important means of increasing bird life, and during the year the number of such reservations was more than trebled, the increase being from 16 to 51. Some of the new reservations differ in character from those previously established. Two in Oregon, on Klamath and Malheur lakes, and one in Alaska, at the delta of the Yukon, comprise considerable areas of marsh land that form breeding grounds of wild fowl. Another, which embraces several of the western islands of the Hawaiian group, covers 5° of latitude and 21° of longitude and contains one of the largest and most famous breeding colonies of sea birds in the world. Others consist of reservoir sites of reclamation projects; these artificial lakes in arid regions will doubtless attract many birds, which in future will be protected.

Apart from their value in increasing bird life, these sanctuaries have an important educational value already being utilized, notably on Tortugas Keys Reservation. There, under the direction of the Carnegie Institution, an investigation of the life history of sea birds has been conducted, and problems of migration, the homing instinct, and other features of bird life have been carefully studied. The first results of this work were published this year by the Carnegie Institution.

GAME REFUGES.

The 20,000-acre national bison range on the Flathead Indian Reservation in Montana will soon be ready for occupancy, and the American Bison Society has already raised $10,500 for the purpose of stocking it with buffalo.

The summer range of the Roosevelt elk, which comprises the higher summits of the Olympic Mountains in Washington, was set aside as a national monument by executive order, issued on recommendation of this Department.

PROTECTION OF GAME IN ALASKA.

Many persons availed themselves of the privilege accorded by the new Alaska game law of shipping trophies out of the Territory prior to September 1, 1908, and the shipments included nearly 175 heads and horns of moose, caribou, and mountain sheep. A few trophies have since come out under license, and the Department has issued permits for the export of 81 specimens, chiefly heads and horns of the above-named species for exhibition at the Alaska-Yukon-Pacific Exposition at Seattle.

COLLECTION AND PUBLICATION OF INFORMATION CONCERNING GAME.

Careful investigation has been made during the year of the present distribution of big game, especially deer and antelope, and the number killed during the hunting season. East of the Mississippi (omitting New Hampshire, Georgia, and North Carolina) 60,000 deer were killed last season. Antelope are still found in 14 Western States, though the total number is approximately only 17,000. Notwithstanding the fact that the antelope is protected throughout the year in practically all the States in which it now occurs, special efforts are necessary to save this fine game animal from extinction. In the decade from 1898 to 1908 the antelope of Colorado, according to estimates of the state game warden, decreased from 25,000 to 2,000.

Statistics have been gathered concerning private and public game preserves, game propagation, hunting-license receipts, and many other special features of game and bird preservation.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

As the Division of Accounts and Disbursements is charged with the auditing and payment of all accounts and claims against the Department, including the administrative examination of the accounts of the Forest Service, and the clerical work required in the proper performance of these duties is directly proportional to the amount of the annual appropriations involved, the routine during 1909 has been somewhat heavier than during any previous year, the 1909 appropriation for the Department being considerably larger in amount than that for 1908 or other preceding fiscal years.

During the year there were received, audited, and paid 56,288 accounts, amounting to $9,359,808.97, exclusive of approximately 32,111 accounts of the Forest Service, which received an administrative examination and audit in the division. Of these accounts, moreover, 3,712 were so-called "combined" accounts, in connection with which there was probably a saving of at least 22,272 checks, to say nothing of the saving of other clerical labor in connection therewith. There were also audited and sent to the Treasury for payment 2,518 accounts. In the payment of the accounts settled directly by the Division of Accounts it was necessary to draw 107 requisitions on the Treasury and subtreasuries, and issue 108,886 checks. There were issued during the year 20,636 requisitions for supplies, 4,101 letters of authorization for travel, 24,687 requests for passenger travel, 1,201 requests on the Quartermaster-General for the transportation of government property, and 1,626 department bills of lading, while 75,750 letters were written or received in the ordinary transaction of business.

With the steady increase in the appropriations from year to year, the special and annual fiscal reports required by legislative enactment have increased both in number and complexity, and as the Division of Accounts is required to superintend and direct their preparation its duties have been materially increased thereby in this direction also, particularly in connection with the annual estimates of appropriations, the annual report of expenditures, the annual report of traveling expenses of employees stationed in the District of Columbia, and the comparative three-year report of expenditures.

By the terms of the agricultural appropriation act for the fiscal year 1909, moreover, there was imposed upon the Chief of the Division of Accounts and Disbursements the additional duty of acting as administrative officer of the fiscal affairs of the Department. In compliance with this provision of law and additional instructions from the Secretary, the disbursing officer has, at stated intervals during the fiscal year 1909, conducted inspections of the property and financial records kept by the several bureaus of the Department. A plan for the keeping of these records in a uniform manner has been devised and applied throughout the Department as far as practicable, and the system inaugurated has done much to simplify the financial transactions between the several bureaus and the disbursing office.

To carry on the work of the Department of Agriculture during the fiscal year ended June 30, 1909, Congress appropriated the sum of $16,063,106, an increase of $2,940,066 over the preceding year. Of this appropriation $11,355,106 covered the ordinary expenses of the Department, $3,000,000 the permanent annual expense for meat inspection, $1,248,000 the agricultural experiment stations, and $460,000 the printing and binding done under the Public Printer.

The disbursements of the Department for the fiscal year 1909 amounted to $14,610,295.64 and the greater part of the balance of $1,634,024.55 will be required for the settlement of outstanding liabilities. The apparent excess of disbursements over the appropriations for this fiscal year is due to unexpended balances, amounting to $181,214.19, brought forward from "Administration, etc., Forest Reserves," and other special appropriations.

The amount paid for rent of buildings in the District of Columbia for the several branches of the Department was $70,245.

All accounts for the fiscal year 1907 having been settled, the unexpended balance of appropriations for that year, amounting to $1,200,165.81 was covered into the Treasury on June 30, 1909. The account for the fiscal year 1908 is still open.

The amount estimated for the fiscal year 1911 in the annual estimates for the regular appropriation bill is $13,377,136, which includes $720,000 for agricultural experiment stations. In addition there will be a permanent appropriation of $3,000,000 for meat inspection, a permanent appropriation of $720,000 for additional allotments to agricultural experiment stations under the Adams Act, and $460,000 for printing and binding to be done under the Public Printer, making a grand total of $17,557,136.

In the estimates for 1911, $397,500 additional is requested for the protection and use of 26,528,439 acres which were added to the national forests during the fiscal year 1909, at too late a date, however, to enable Congress to provide therefor in the agricultural appropriation act for 1910; while in the Division of Publications the amount requested for labor-saving machinery and photographic equipment for 1911 is $2,400 less than the amount provided for 1910, and in the Bureau of Animal Industry $13,000 less is requested for use in connection with the Bureau experiment station during 1911 than was provided during 1910, making the net increase of the 1911 estimates over the 1910 appropriations $382,100, exclusive of the additional allotments to agricultural experiment stations under the Adams Act. Numerous minor changes have also been made in the estimates, none of them, however, affecting the total amount requested. In the appropriation act for 1910, several of the lump-sum appropriations were broken up into numerous more specific subappropriations, and in the 1911 estimates this plan of subdivision has been considerably extended, notably in connection with the work of the Forest Service. While it is readily seen that this division of lump-fund appropriations into more numerous subappropriations will enable Congress to appreciate more fully how the money for the Department is to be expended, and will, on the whole, make for economy of expenditure, it is equally apparent that the bookkeeping and other clerical work of the Division of Accounts in connection with the large numerical increase in the appropriations will be considerably heavier than heretofore.

DIVISION OF PUBLICATIONS.

During the year 1909 the publication work of the Department exceeded that of any preceding year. A larger number of different publications were issued, and a greater number of copies were printed and distributed. Such an increase was to be expected. Publication is the principal means by which practical effect is given to the studies, investigations, and experiments of the Department. The rapid growth of this Department and the extension of its activities must be accompanied by an ever-increasing volume of printed matter if the Department is to accomplish the purpose of its existence.

The total number of different publications ordered printed during the fiscal year 1909 was 1,200, containing a total of 42,263 printed pages, and the total number of copies was 17,190,345. Of these about 60 per cent represented new publications of the year. These figures do not include an aggregate of more than 10,000,000 copies of weather maps and other minor publications issued from the Weather

Bureau stations outside of Washington. Neither do they account for the printing and distribution by Congress and by the Superintendent of Documents of several million copies of important publications contributed by this Department.

That the publication work of the Department is receiving the attention which it deserves is proven not only by the absence of criticism but by the great and growing demand for the Department's printed matter. In all lines of the work high standards have been set, and the work of the past year shows that the Division of Publications has met the requirements of these standards. The limitations of the printing fund have made necessary the most rigid economy in printing, illustrating, and binding in order to secure the largest possible output of the very best reading matter on all lines of agricultural research and experimentation.

SALE OF PUBLICATIONS.

In order to avoid wasteful distribution of printed matter, it has been necessary to limit more strictly the gratuitous distribution and to depend more largely on the sale of publications by the Superintendent of Documents at prices sufficient to cover the cost of printing. That official reports for the past year a greater sale of this Department's publications than ever before. The total number of copies sold during the year was 117,218, and the amount received for these was $16,293, an average of about 14 cents per copy. The sales of a single publication, that popularly known as "The Horse Book," netted more than $1,100. The sale of agricultural publications has trebled within three years. The most commendable feature of this system is the use of the money resulting from sales in reprinting publications to supply the demand. By this means a large number of valuable publications are made continually available. The Superintendent of Documents during the fiscal year reprinted 55 publications of this Department, issuing a total of 44,354 copies.

FARMERS' BULLETINS.

The first number in the Farmers' Bulletin series was issued in June, 1889, just twenty years ago. The latest issue of the year just closed was No. 361, and the number of copies issued within the twenty years reached the enormous total of 69,454,000. This series embodies the idea of supplying farmers with brief, inexpensive bulletins, written in clear, nontechnical language and filled with practical information. It took several years for the Farmers' Bulletins to gain extensive popularity, but since 1895, when Congress voted annual quotas for distribution by its Members, the growth of the series has been phenomenal.

During the past fiscal year 34 new numbers were added to the Farmers' Bulletin series and two earlier numbers were revised. Of these 1,295,000 copies were printed. Of the earlier issues 235 were reprinted, the number of copies issued being 6,460,000. The total copies of all new issues and reprints amounted to 7,755,000, an aggregate exceeding the total output of any previous year by more than 1,100,000 copies.

I believe it may be safely asserted that practical agriculture in the United States has received more actual benefit through the issue and wide distribution of Farmers' Bulletins than from any other single source.

In view of the limitations necessarily placed on the printing and distribution of the Department's more expensive publications, the importance of maintaining and extending this series is continually increasing. The demand for Farmers' Bulletins is increasing more rapidly than the supply. These facts clearly indicate the necessity for an ample fund to be used in the printing and distribution of these free popular bulletins.

Prior to the year 1908 Congress, in setting apart funds for printing Farmers' Bulletins, provided that undistributed quotas of Senators, Representatives, and Delegates should, after a fixed date, revert to the Secretary of Agriculture, so that the supply of bulletins on hand might be reapportioned in making up quotas for the succeeding Congress or used by the Secretary in supplying miscellaneous demands. This excellent provision periodically relieved the limited storage facilities of the Department, and at the same time enabled the head of the Department to get these valuable publications promptly into the hands of practical farmers instead of allowing them to accumulate in anticipation of congressional orders which might never come. The inclusion of this reversion clause in future appropriation acts is greatly to be desired.

BUREAU OF STATISTICS.

During the year substantial progress has been made in strengthening the organization of the Bureau, perfecting its methods, extending its operations, and conducting special investigations.

GENERAL OUTLINE OF THE BUREAU'S WORK.

The principal lines of work carried on in the Bureau of Statistics may be stated as follows:

1. Gathering and digesting statistical data in regard to crop conditions, with monthly publication of results.

2. Gathering and digesting information in regard to domestic production of crops and farm animals, with annual publication of results.

3. Studies of the import and export trade of the United States in agricultural and forest products, with annual publication of results.

4. Studies of agricultural production in foreign countries and their export and import trade in such products, with compilations published annually.

5. Special studies and investigations of (*a*) agricultural production in the United States over long periods; (*b*) the foreign production of certain crops over long periods; (*c*) foreign markets for the agricultural surplus of the United States; (*d*) problems relating to the transportation of farm products within the United States and across the seas; and (*e*) various important phases of agricultural industry and rural life.

The work under the first two heads—the investigation of crop conditions during the year, and of annual production—is by far the most important, as it is through such work that this Department exercises an important influence on commerce by giving to the world advance information concerning its food supply. Without doubt the statistical data collected and published by this Department give stability to our markets, tend to prevent market manipulators from causing undue fluctuations in prices, and thereby aid the American farmer toward securing just and fair returns for the products of his labor and his invested capital. It should also be added that it is in these two fields of official endeavor that our statisticians secure the original data which form the basis of later and larger studies.

During the year the work of the Bureau was pushed vigorously and successfully along all the lines indicated above.

CROP-REPORTING SERVICE.

In its efforts to secure accurate first-hand information concerning crop conditions, acreage, and yields the Department has perfected an organization which practically covers the entire country four times. There is, first, a corps of township correspondents, at present numbering about 33,000. These report directly to the Bureau for their respective localities. Second, there is a corps of county correspondents who report directly to the Bureau, there being one in practically every one of the 2,800 agricultural counties of the United States. Each of these correspondents usually has two or more assistants located in different parts of the county who report to him. Third, there is a state statistical agent in each State, who has a large corps of local correspondents reporting to him. He not only tabulates these returns, but makes personal observations and reports monthly to the Bureau. Fourth, there is a corps of special agents, each an expert statistician, traveling over a definite area, making personal investigations and securing information from a variety of sources, and reporting directly to the Bureau. Here, then, we have what might be termed a quadruplication of original research which is practically continuous throughout the year. Besides the special agents and state agent who receive salaries, there are in all about 135,000 voluntary correspondents, mostly farmers, who serve the Department with no compensation other than a limited number of publications and a small supply of seeds. This number includes about 25,000 representative farmers who are called upon at the close of each crop season for a report based on results of their individual farming operations. In addition to the foregoing, there are special lists of cotton, rice, and tobacco correspondents from whom data relating to these crops are secured; and supplementary data regarding wheat and cotton yields are secured, respectively, from millers and cotton ginners.

The Bureau secures its original data mainly by sending out blank forms or " schedules " to be filled and returned by correspondents of the several classes. During the fiscal year 1909, 1,509,000 copies of these blanks were sent out. A greater percentage of these were filled out and returned than in any previous year. Of the county reports, 76 per cent were returned, as compared with 74 per cent in 1908. The percentage of schedules filled and returned by township correspondents in 1906 was only 48 per cent. By 1908 it had increased to 63 per cent, and during the last year it was 66½ per cent. This shows gratifying progress in perfecting the Bureau's organization and increasing interest and appreciation on the part of the farmers.

CROP-REPORTING BOARD.

The reports from each class of voluntary correspondents are tabulated and computed separately, and the data from all the original sources are handled by the crop-reporting board, composed of the Statistician, the Assistant Statistician, one expert statistician in the Bureau, and two special or state agents called to Washingon for this service. The reports derived from the data secured from each original source are taken in hand by the members of this board individually at first and then all act together in arriving at the general average of results. This year, as during several preceding years, this board has done its work under regulations and safeguards which make it impossible for advance information concerning the final figures to be secured by any means, and public confidence in the efficacy of the methods and the honesty of the service appears to be perfectly established.

By the organization and methods just described this Department arrives at an estimate of the crop prospects at the end of each month with the accuracy and reliability of which it is believed no similar estimate made by private agencies can approach.

SPECIAL INVESTIGATIONS.

A number of important special investigations are in progress in that branch of the Bureau known as the division of production and distribution. Among these may be mentioned the study of transportation problems; investigations of the supply and demand for wheat and meat products; the study of foreign markets in general; studies of the cost of producing various crops; the collection of data in regard to cooperation among farmers in selling and buying, fire and live-stock insurance, telephone service, etc.; and an inquiry concerning the dates of planting and harvesting a large list of crops in different sections of the United States. On some of these lines of investigation important papers have already been published, and on others publications will be issued as the progress of the work justifies.

THE LIBRARY.

The demands on the Library by Department workers and other scientists engaged in agricultural research continue to increase. The charges recorded at the loan desk during the year numbered more than 30,000, and in continuance of the policy of cooperation about 400 books were loaned to scientists connected with the various agricultural colleges and experiment stations in the different States and in Canada.

Accessions during the year numbered 4,300, among them being many important reference books. Purchases are limited to subjects of special interest in connection with the work of the Department. Valuable publications have been received from all the States and from many foreign governments. Many of these publications probably are not to be found in any other library in this country. The total number of books and pamphlets on hand at the close of the fiscal year was 104,300.

The quarterly bulletins enumerating the accessions to the Library have now attained such a size as to make it seem advisable to publish the list monthly in order to increase its usefulness.

An important work of the Library is the distribution of publications to foreign countries. The foreign mailing lists of the several Bureaus being in its charge, duplication in the sending out of publications is avoided; they are placed where they will be of most service, and useful material is secured in exchange.

The work of indexing and cataloguing, some of which is done in cooperation with the Library of Congress, is on the increase, as well as important work in other lines peculiar to the Library.

OFFICE OF EXPERIMENT STATIONS.

RELATIONS WITH AGRICULTURAL EXPERIMENT STATIONS.

The agricultural experiment stations throughout the United States are increasing the extent and variety of their work, and are reaching the farmers more effectively than ever before. Through substations, demonstration fields, cooperative experiments, special railroad trains, farmers' excursions to the stations, exhibits of improved products, live stock, machinery, etc., at county, state, and national fairs, the practical results of experimental work are being brought home to multitudes of farmers in every State. Cooperation with this Department is being largely increased, and the inspection service of the stations is being broadened.

These things have greatly enlarged and complicated the duties of the Office of Experiment Stations in supervising the expenditures of the federal funds granted to the stations, in summarizing the state publications for dissemination of information of general value throughout the country, and in otherwise promoting the interests of the stations.

Special attention is now being given to the stricter differentiation of the work and publications of the stations as related to the extension departments which are being rapidly organized in the agricultural colleges. It is fortunate that extension work is growing apace, and it will be doubly so if the extension departments are so organized and manned as to relieve the stations of a great burden of routine work which they have been vainly trying to carry. Legislatures, governing boards, and the public generally will do well to draw a clearer line between experimental and demonstration work, and while they liberally support the new extension departments of the colleges, they should not forget the needs and requirements of the stations. Public applause, easily, and oftentimes deservedly, accompanies the successful efforts of the demonstrator and lecturer. We are apt to forget the patient investigator who in the laboratory or field is quietly getting the facts and solving the hard problems. We must give him more of our confidence and support, and strive more earnestly to smooth his way to success and make him contented with his task if we are to keep our ablest men in this service and get the greatest results for the improvement of our agriculture. It is impossible for public institutions to compete with private concerns in the financial rewards for scientific service. But the public may so treat and encourage its faithful scientific servants that men of the highest order will gladly devote their lives to the public service. To maintain agricultural research at its highest and best estate in both the national and state service is now one of the most important problems before the American people.

To aid our agricultural scientists in the Department and the colleges and stations in keeping thoroughly informed of the progress of agricultural science throughout the world, special efforts have been made during the year to bring the Experiment Station Record more closely up to date. Twenty volumes of the Record have now been completed. These contain reviews of 71,650 articles, gathered from all quarters of the globe. In this great literature the United States is represented by 3,055 publications of this Department and 7,780 bulletins and reports of the state experiment stations.

By far the greatest part of the work of all institutions for agricultural research consists in the gradual accumulation of data by which light is thrown on agricultural problems and their solution thus gradually brought about. This may be illustrated by brief reference to some of the lines of work in which our stations are now engaged.

Much profitable work is now in progress at the stations on the principles which lie back of the breeding of domestic animals. It will necessarily take years to secure conclusive results.

In the feeding of animals the Missouri Station has conducted a remarkable series of experiments upon the use which steers make of their feed under different methods of feeding, and the Wisconsin Station is showing that, in their effect upon the animals, there are differences between feeding stuffs which are not shown by the composition and digestibility.

Several of the experiment stations are making important discoveries which show bacteria and other microscopic life in the soil to play an important part in soil fertility. Culture is shown to benefit the plant in part by providing favorable conditions for the helpful activity of these organisms.

Success in growing alfalfa in the northeastern States is being gradually attained, and the experiment stations have developed methods by which this valuable forage plant can be grown in New York and the New England States.

Weed seeds in commercial feeding stuffs have been found to be an increasing source of contamination. Some by-products and mixed feeds have been found to contain from 5,000 to 80,000 weed seeds per pound. A large part of these pass into the manure without losing their vitality.

Great progress has been made in the use of miscible oils for spraying for scale and other insect pests on fruit trees. The crude and refined oils are likely to injure the trees; but after much experimenting the stations have devised a means of preparing a miscible oil which is effective and safe.

Studies of ice cream at several of the stations show that there are definite laws as to the relation between the degree of cold, the strength of the cream, rapidity of freezing, and the volume of the product. These things are being formulated into practical directions for ice-cream manufacture.

AGRICULTURAL COLLEGES AND SCHOOLS.

During the year the agricultural colleges have given instruction in agriculture to more students than in any previous year, and have also done more effective work along other lines. Several of the biennial state appropriations for these institutions have approached or passed the half-million mark, notably in Montana ($487,000), Pennsylvania ($526,000), and Kansas ($671,000). The growth of the agricultural colleges is also indicated by the number and character of college buildings completed during the year. Among the more important of these were the following agricultural buildings: Georgia, $100,000; Iowa, $400,000; Maine, $50,000; Michigan, $175,000; Missouri, $100,000; and Montana, $80,000. Wisconsin has completed a $75,000 live-stock pavilion, and California has started work on a $200,000 agricultural building. The third session of the Graduate School of Agriculture, held at Cornell University, had a larger attendance and was more generally successful than either previous session; graduate schools offering courses in agriculture were established in Illinois and Massachusetts; faculties and courses of study were reorganized on broader lines in Alabama, Arkansas, Georgia, Louisiana, Massachusetts, Oregon, Rhode Island, South Carolina, and Wisconsin; definite provision for training public school teachers of agriculture or for aiding them through extension departments or special publications is now made by agricultural colleges in twenty-seven States, and fully as many of these institutions are engaging actively in other forms of agricultural extension work. New agricultural colleges have been established in Hawaii and Porto Rico, and the former was opened early in 1909.

Secondary courses in agriculture have been started in connection with the agricultural colleges in Montana, Oregon, South Dakota, Texas, and Virgina; two district agricultural high schools have been provided for in Idaho, likewise four in Arkansas with a total appropriation of $160,000, two more in New York with a total appropriation of $100,000, and five in Oklahoma, two of which have been located and have received $20,000 each for buildings and $12,000 each for maintenance. Subsidies have been voted to encourage the teaching of agriculture and domestic science in public high schools as follows: In Texas, $32,000; in Minnesota, $25,000 for ten schools; in Virginia, $20,000 for ten schools; in Mississippi, $1,000 for one school in each county; and in Louisiana $500 to each school approved by the state board of education. In Massachusetts the Smith Agricultural School and Northampton School of Technology has been opened at

Northampton and smaller agricultural high schools at Petersham and Montague.

The introduction of agriculture into the elementary schools has also been promoted actively. In this work the colleges have been particularly active through their summer schools and other teachers' courses and through the preparation of courses of study and school leaflets and the encouragement of boys' and girls' clubs. These clubs are coming to be very effective agencies for interesting young people in agriculture and home making and are now reported from twenty-nine States with a total membership of upward of 150,000. Agricultural college men have also been active in the preparation of text-books and manuals for secondary and elementary schools. One secondary and six elementary texts were published during the year.

In all this work of providing facilities for graduate study in agriculture, reorganizing and strengthening college courses, and multiplying opportunities for acquiring secondary and elementary instruction in this subject, the Department has given its assistance and encouragement through its several branches and particularly through the agricultural education service of the Office of Experiment Stations. The Director of that Office has continued to represent the Department in its relations with agricultural colleges and schools in this country and abroad and has accepted an invitation to act as dean of the fourth session of the Graduate School of Agriculture at Ames, Iowa, in 1910. As chairman of the committee on instruction in agriculture of the Association of American Agricultural Colleges and Experiment Stations he has been engaged in preparing a four-year college course in home economics and a one-year course in animal husbandry and dairying for public high schools.

The Department recognizes the fact that teachers and pupils in the public schools are most effective agencies in the rapid and widespread dissemination of information and that the sending of suitable agricultural literature to the public school teachers who request it is likely to be productive of great good. And while it is true that many of the Department publications are suitable in their present form for use in public schools and many thousands of them annually go into the schools, it is also true that much needs to be done in the way of preparing agricultural literature and compiling information with special reference to the needs and limitations of pupils in the public schools. This function the Department has begun to exercise and proposes to develop more fully in future.

FARMERS' INSTITUTES AND AGRICULTURAL COLLEGE EXTENSION WORK.

Six years ago Congress made an appropriation of $5,000 to this Department to enable it to provide a special officer to investigate and report upon farmers' institutes and similar organizations in this and foreign countries. At that time the attendance upon the institutes in the United States was reported at 820,000. Now all of the States have institute organizations, and there were held last year 4,926 regular institutes consisting of 15,210 half-day sessions, with a total attendance of 2,196,568, and including railroad specials, round-up institutes and other forms of institute activity of almost three millions (2,906,699). This represents an increase in attendance at the regular institutes over the year 1903, when the Department first secured an appropriation for conducting investigations along institute lines, of more than 167 per cent, and if all forms of institute activity are included of about 270 per cent. The appropriations by the States for the support of these institutes for the last year amounted to $338,000.

Extension courses in agriculture have now a recognized place in the system of instruction provided by the land-grant colleges. This Department can materially aid this movement by adding to its present force of investigators a number of expert specialists who shall devote their time to perfecting forms of organization and devising methods of demonstration along extension lines and to conducting extended investigations and researches relating to the extension of agricultural instruction. The extension feature in the teaching of agriculture has suddenly come into such prominence as to make it incumbent upon this Department to recognize it and give it assistance at least equal to that which it now gives to the colleges in their resident instruction and to the experiment stations in conducting researches and investigations.

Normal institutes for the instruction of farmers' institute teachers have now become a part of every well-organized institute system. Eight of these normal schools were reported during the year, with an attendance of 1,000 institute lecturers.

Fourteen States ran railroad specials and report an attendance of over 159,000. Numerous other railroad specials were conducted by state boards of agriculture and by the agricultural colleges, independent of the institute organizations. More than any other agency these specials have interested the managers of the transportation companies in the improvement of agriculture. The railroad companies now not only furnish trains to the institute directors free of charge, but they provide also board and lodging for the instruction force.

Movable schools of agriculture are fast becoming leading features in farmers' institute development, over 2,500 persons being registered as students in these schools during the year. The instruction is given by skilled teachers to classes of adults regularly organized, and the sessions continue from one to three weeks in a locality. Wherever they have been tried they have been found very satisfactory. The Department has had prepared model courses of study for use in such schools, and has in preparation additional courses, some of which it hopes to equip and put into operation as illustrations of the best methods of conducting them and as demonstrations of their practicability and value.

Special subject institutes are being introduced in many of the States. Where these are conducted the entire institute period is devoted to the treatment of a single subject, discussing it thoroughly in all of its features. This form of institute has been found to be much more valuable than an equal amount of time given to the superficial discussion of several topics. Over 17,000 persons were in attendance upon meetings of this character during the year.

Institutes especially intended for women are rapidly being organized. Twenty-one States held institutes of this character in 1908. The need for more definite instruction for country women in domestic and sanitary science and household art than is given in the ordinary institutes for men has brought about a great demand for institutes for women. To a great extent the mental, moral, and physical welfare of the family depend upon the home keeper, yet hitherto her opportunities in the country districts for qualifying herself for fulfilling her duties have been chiefly such as she could create for herself. The women's institute is a step in the direction of supplying this need by furnishing information to women at their homes of a kind most helpful and best adapted to their wants. A circular has recently been issued upon this subject by this Department, calling attention to the importance of the work and outlining methods by which women's institutes may be organized and successfully conducted.

THE DEPARTMENT'S INSULAR AGRICULTURAL EXPERIMENT STATIONS.

In Alaska during the past season special efforts have been made to develop the station near Fairbanks, in the Tanana Valley. In order to equip and develop this it was found necessary to close the Copper Center Station temporarily, and the buildings and lands have been turned over to the Bureau of Education of the Department of the Interior for use until such time as this Department desires to resume work at that place. The investigations with cereals are being extended, and while, in 1908, 57 out of 65 varieties of grains fully matured at the Rampart Station, located 65° 30′ north latitude, the results this year were still more favorable, practically every variety of spring grain ripening its crop. Winter rye and winter wheat survived the rigors of the winter and were fully matured where the snow was not blown from the plats. Oats sown for hay produced a heavy crop of grain, and it can be confidently asserted that barley and oats can be successfully grown in the Yukon and Tanana valleys, so as not only to supply the needs of the grower, but also to yield a surplus for market. The selection and breeding work with cereals is being continued, and some forms have been bred that appear to be superior to the original varieties from which they were obtained. It is believed that within a few years varieties will be developed that are fully adapted to Alaskan conditions. The experiments at Fairbanks have not been in progress long enough to warrant definite statements regarding them, but the results thus far obtained have been quite favorable, and it is intended at this station to prove or disprove the possibility of profitable farming in that portion of Alaska. The Galloway cattle at the stock-breeding station on Kodiak Island wintered satisfactorily without any shelter other than that afforded by an open shed. During the summer they grazed on native grasses and throughout the winter were fed exclusively on hay and silage made from native grasses. A larger range for the stock has been fenced during the season just past. The horticultural investigations conducted at the different stations have fully demonstrated the possibility of producing an abundance of hardy vegetables of good quality. The special agent in charge reports the fruiting of more than a thousand of the strawberry plants produced by crossing the wild and cultivated varieties, and the fruit of some of the plants compared favorably in size and quality with the best of the cultivated varieties. It is believed that the hardiness of the native variety and the quality of the cultivated ones have been successfully blended in the new varieties.

The efforts of the Hawaii Station to diversify the agriculture of those islands are beginning to show results. The discovery of some of the difficulties attending the shipment of fresh fruit and means for their control has been followed by greatly increased shipments, particularly of pineapples. Methods for the propagation of citrus, mango, and avocado trees have been worked out, and with the investigations now in progress in orchard management it is believed that most of the obstacles that have prevented the increased production of tropical fruits will be removed. The rice investigations, which have been in progress for several years, have developed better and more prolific varieties and have made possible the devising of methods for the fertilization of the crop which more than double the yield of ordinary rice lands. Great interest is being taken in the experiments with cotton, especially with the Sea Island varieties, of which the station has several well-marked strains. Heavy yields of all the varieties have been obtained, and of some of the Sea Island strains the yield exceeds anything hitherto reported, while the quality of the fiber is most excellent, the fiber being in some cases very silky and more than 2 inches in length. It has been found possible to grow cotton either as an annual or as a perennial, and when it is grown as a perennial by pruning and cultivation the time of maturity of the bolls can be controlled. As a result of the station's experiments about 100 acres were planted to cotton this year and probably 1,000 acres will be planted in 1910, some of the areas formerly in cane being given up to this new crop. The station has devoted considerable time to a study of the causes of the yellowing of pineapple plants in the field, and it has been found chiefly due to the presence of large amounts of manganese in the soils. Experiments are now in progress to overcome the undesirable soil conditions. The rubber investigations have been highly satisfactory, and as a result of experimental tappings of 500 trees the most economical methods of tapping and coagulating the latex have been worked out. The experiments have shown the possibility of the profitable production of rubber from Ceara trees in Hawaii. There are now 1,500 acres or more of rubber trees planted in Hawaii, and the profitableness of the new industry seems to be assured.

On account of the primitive condition of agriculture in Porto Rico, much of the work of the station is devoted to demonstrations. Investigations are being carried on by the different departments of the station, however, and results of immediate benefit have been obtained. Especial attention is now being given to the production of citrus fruits. Wind-breaks for orchards are being extensively planted as a result of the station's demonstrations. The work with pineapples has practically revolutionized the former practices and has made possible the considerable expansion of that industry. Important studies on Porto Rican soils have been begun, looking toward the renovation of the soils that have become worn through continued cropping. A study has been made of the reason of the lack of fertility in certain soils and a cause determined, together with methods for its control. One of the chief causes for the so-called "tired" or "sick" soils was found to be of bacterial origin, which can be corrected by cultural and other methods. An important contribution of the station to the agriculture of the island has been the introduction of improved cane seedlings, and these are being planted as rapidly as the station can supply the demand. The highly valued coffees of Arabia, Java, and other countries have been introduced, and from the few fruits that have been borne it is evident that the peculiar flavors which characterize them have been retained. These are being propagated and distributed as rapidly as possible, in order to supply a kind of coffee better suited to American tastes. Considerable advance is being made in the improvement of the live stock of the island. The station has introduced several breeds of cattle, swine, and poultry, and is disposing of the surplus, but the supply is not at all equal to the demand. It has also introduced woolless sheep for mutton purposes, milch goats, Brahman cattle, and saddle-bred horses, all of which are being used in breeding experiments. An experiment has been successfully carried on in ensiling Para grass and cane tops, when they are plentiful, for feeding during the dry season. The station has introduced some Italian bees and established an apiary, the increase from which is in great demand. While the honey produced is a direct source of income, the presence of large numbers of bees will, it is thought, assist in better pollinating the coffee during the short period of its flowering and thus contribute to the general prosperity of the island. The material equipment of the station has been greatly increased, and a new office and laboratory building provided by insular funds has been completed and equipped.

After a considerable delay negotiations were completed for a site on the island of Guam, and preliminary work was begun for the establishment of an agricultural experiment station. The work at this station for some time will of necessity be confined to the introduction of improved varieties of crops and animals and demonstration experiments. Agriculture in Guam is extremely primitive, and only by repeated object lessons will much advance be obtained. A considerable number of varieties of grains, fruits, forage plants, etc., have been introduced, and their adaptability is being determined. A period of unusual drought was experienced in Guam early in 1909, and as a result planting was considerably delayed. Kafir corn of several varieties has been introduced and the growth the first season was all that could be desired. Not only was a large amount of forage produced, but it yielded heavily in grain. Experiments are being conducted with a large number of varieties of maize, tropical fruits, and forage plants, many of which were sent from the Hawaii Agricultural Experiment Station. The tropical fruits are reported as growing vigorously, and the varieties are believed to be superior to those already growing in Guam. They should prove to be valuable additions to the economic plants of the island. Other economic plants have been introduced from Java and elsewhere, and as rapidly as supplies are on hand they will be distributed to the people for cultivation. In order to increase the amount of forage and to restore the former fertility of the soil a considerable number of varieties of leguminous plants have been introduced to grow in rotation or between the rows of other crops. An experiment is in progress to determine the possibility of reclaiming some of the savanna lands that are now of little value. These soils are low in nitrogen and organic matter and are very retentive of moisture. A small area has been planted to a leguminous shrub in the hope that this will grow in the savanna soils, and after becoming established will serve as a shade for more valuable species. Cooperative experiments have been begun in a limited way with a few farmers, and seeds of field and garden crops have been gladly accepted for trial planting by quite a number of ranchers.

NUTRITION INVESTIGATIONS.

A problem of special importance which is being studied in the course of the nutrition investigations of the Office of Experiment Stations is the ease of digestion of cheese made in different ways and cured for varying lengths of time, such data being needed to round out the extended series of investigations which have demonstrated the thorough digestion of cheese and its great value as an article of diet when used in quantity. Information will also be sought by means of experiments with the respiration calorimeter (which has now been reconstructed in Washington) regarding the comparative value for the body of olive oil, lard, butter, beef suet, and other table and culinary fats. Studies are also contemplated which will supply additional and much needed data regarding the value as food of fruits and nuts and products made from them. In all this work the respiration calorimeter is essential for measuring factors which can not be determined by any other means.

For several years studies were carried on of the food value of meat of different kinds and cuts prepared for the table in various ways, and much valuable information was provided as a result of this work. From the data at hand and the results of some special tests, a summary has been prepared regarding the use in the home of the cheaper cuts of meat, a question which is now of decided importance in economical household management.

The nutrition investigations of the Department have an intimate relation to the work of the experiment stations and the agricultural colleges. In response to a widespread demand from farmers and others, some of the experiment stations are studying problems which pertain to human food, while the agricultural colleges are conducting courses in home economics in which instruction concerning the nutritive value of different foods and ways of handling and cooking them are important features.

A recent act of Congress has stimulated the agricultural colleges to organize courses for teachers along this line as well as other branches of agriculture and mechanic arts. The work is also being taken up by primary and secondary schools all over the country, and is growing so rapidly that the demand for teachers and information exceeds the supply.

Students, teachers, investigators, managers of institutions where large numbers of persons must be economically fed, and housekeepers and other individuals interested in home problems are turning to the Department in increasing numbers for publications and other information and for suggestions.

IRRIGATION INVESTIGATIONS.

During the year the activity in the construction of irrigation works has not lessened, but, if anything, has increased. New works are built at a constantly increasing cost, requiring more capital in the hands of settlers and the growing of more valuable crops, thus limiting the number of people from whom settlers may be drawn, and restricting also the range of crops which can be grown at a profit, making the securing of settlers more difficult and decreasing their chances for success. For these reasons there is great danger of overbuilding and a recurrence of the experience of twenty years ago, when canals were built so far in advance of settlement that the lands under them are not all reclaimed yet. With the present cost of water rights and the large expense of preparing arid lands for the growing of crops under irrigation, settlers can not afford to spend either time or money in working out for themselves the best methods of preparing their land for irrigation, of building their ditches and other structures, and of applying water to their crops. For this reason the irrigation investigations carried on by this Department have for the past few years been devoted very largely to collecting information as to the best methods of performing all the agricultural operations connected with irrigation, and supplying this information to settlers, principally in the form of practical bulletins, but also by demonstrations on farms maintained in cooperation with several of the state experiment stations and by personal advice and public lectures.

The activity in construction of irrigation works and the widespread promotion of these enterprises have created a great demand for reliable information as to the agricultural resources of the arid region, the laws and institutions controlling the use of water in irrigation, and the cost of water, methods of using it, crops grown, etc. This has been met to a considerable extent during the past year by the publication of a series of reports on irrigation in the several States and Territories of the arid region, the effort being to bring together in these bulletins, from reliable sources, the information needed by persons considering settling in that section. Eight of these bulletins have been published during the year.

There are, however, sections where the demand is not for more settlers but for more water. The available water supply has been utilized, and agricultural extension depends upon a more economical use of this supply. Eventually this will be the prevailing condition throughout the arid region, since under the most economical use only a small part of the arable land can be irrigated. On the basis of studies made by the Department it has been estimated that the water at present turned into the main canals in the arid region can be made to serve approximately double the area now irrigated with it, since not much more than half the water entering the canals reaches the land, and there are large losses in application. The prevention of these losses in transmission and in application to fields is the most promising source of an increased water supply. Much attention has, therefore, been devoted to determining how much water is required to grow crops under different conditions, how much is lost, the source of loss, and the means of preventing losses. This involves experiments to determine the moisture conditions under which crops make their best growth, and to work out methods of securing and maintaining these conditions, with the use of a minimum quantity of water, including the adaptation of methods of applying water to different types of soils, the quantities of water which should be used in each application, and the methods of cultivation which most effectually protect the soil moisture from evaporation; measurements of water flowing in canals to determine the magnitude of losses in transmission, and the points at which losses occur; and the experiments with different methods of lining canals to stop seepage losses. Our investigations show also that the laws and regulations under which water is distributed to irrigators and the systems of charging for the water used have a great influence upon the efforts made to economize in its use, and these systems are being studied from that standpoint. By demonstrating the extent of losses and the possibility of eliminating them, and by working out systems of management which will give the incentive necessary to induce water users to use no more water than is necessary, the Department may be the means of doubling the area irrigated at an expense that is merely nominal as compared with the expense of developing additional water supplies and building the works to make them available.

Settlement on the semiarid plains has continued during the past year, with little diminution, but each added year of experience demonstrates more fully the value of the plan advocated by this Department of irrigating small areas in connection with the farming of larger areas without irrigation as an insurance against total crop failure and to provide a home-grown food supply. The farms established several years ago for the purpose of determining and demonstrating the value of this practice and the methods to be employed have been maintained during the year. In addition, information as to the use of windmills for pumping water for irrigation on the plains has been collected and prepared for publication, and accurate tests of mills of different types have been made, in order to supply information as to their most economical use and to work out improvements in their construction. These tests promise to bring about improvements by which a much larger part of the power of the wind may be utilized, making it a most valuable source of power.

The recent years of drought in the East and the spread of intensive farming in that section have caused eastern farmers to realize that they can not afford to depend entirely upon rainfall for the maturing of their crops, and they are calling upon this Department for information as to methods of securing and utilizing water supplies for irrigation. In response to this demand, an expert has been detailed to the eastern field and is devoting his time to a study of eastern conditions and the adaptation of western irrigation methods to these conditions.

DRAINAGE INVESTIGATIONS.

DRAINAGE IN THE IRRIGATED REGION.

Among the most important investigations in drainage are those which are conducted upon irrigated lands. For years it has been known that some irrigated fields easily become swamps, while the productiveness of others is ruined by the accumulation of injurious alkali. The lands which are most easily irrigated by water from the mountain streams, and which are surprisingly productive when first reclaimed from a desert condition, not infrequently become noisome bogs or alkaline wastes after a few years of cultivation under copious irrigation. This is true of a portion of every irrigated valley in the West. Utah contains not less than 150,000 acres of such land; Colorado, 75,000; California, 100,000; Nevada, 250,000; Wyoming, 50,000; Montana, 60,000; Idaho, 40,000, all having been once cultivated and still having valuable water rights. These are conservative estimates, showing the gravity of the situation, and when considered from the point of the owners particularly emphasize the importance of using preventive as well as curative measures in the treatment of saturated lands which are under irrigation.

OVERIRRIGATION NOT ALONE RESPONSIBLE.

While an injudicious use of water and a faulty distribution system hasten the formation of seeped land, it is acknowledged by good irrigators that in ordinary farming practice there is a waste of water which can not well be avoided. Where there is not good drainage, the surplus water accumulates until evil results appear.

Experiments and examinations have brought out some useful as well as encouraging facts about seeped lands and the methods of restoring them to productiveness. The changing of a productive soil into a bog or alkali waste is a process hidden from view, and, like an insidious disease, is often not discovered until disastrous results are manifest. The lower lands begin to fill with water at varying depths from the surface, the level rising gradually until it reaches the surface. The movement of the soil water is modified by hardpan gravel and shale formations, as well as by other less pronounced physical characteristics. The effects manifest themselves by the utter failure of crops in spots, which enlarge yearly until the entire field becomes barren and often so soft that it can not be crossed by teams. The injury extends from farm to farm until the larger part of an irrigated valley becomes covered with salt grass, alkali weeds, or, in many instances, becomes a barren alkali waste.

PRINCIPLES WHICH APPLY IN DRAINING IRRIGATED LANDS.

The restoration of such land, as determined by investigations and experiments conducted by this Department, may be accomplished by suitable drains located in accordance with a few simple laws which are found to govern the behavior of water, particularly the underflow in irrigated soils. These laws are briefly as follows:

The source of the surplus water is the leakage from canals, but more especially the waste water from irrigated lands which occupy the higher levels.

Soil water is frequently deflected in its course, as it percolates through the soil, by layers of hardpan. Water which finally reaches the lower lands is arrested in its downward percolation by comparatively impervious earth, and then rises year by year until the surface is saturated.

Water dissolves a considerable quantity of the salts which are present in the soil. When evaporation takes place at the surface the salts, many of them being injurious to plants, accumulate rapidly.

METHODS OF DRAINAGE.

While such lands in the several irrigated districts show great differences in condition and in the facility with which they may be reclaimed, as well as in relative value after restoration to a productive condition, the following methods have in most instances proved effective.

One drain should be placed along the upper edge of the wet land approximately across the surface slope and sufficiently deep to intercept the underflow from the higher land. Frequently this depth must be from 5 to 7 feet. The drain may be a large open ditch, a covered lumber-box drain, or a large pipe, according as may be expedient in such locality. Where the land lies in a series of benches, drains should parallel the upper border of each bench.

A few drains are usually required in the lower parts of the fields to remove surplus water which is supplied directly by irrigation or rainfall. These should be located in the depression, but should not be constructed until the intercepting drains have cut off the supply from outside sources.

Drainage wells have proven effective where gravel formations are found bordering the saturated lands. When placed at well-selected intervals and sunk to a depth of 8 to 10 feet they collect free water which, rising in the wells, is removed by tap drains placed at convenient depths and discharging into some adequate outlet.

These measures, simple in principle and easily described, are sometimes difficult to carry out. A thorough examination of the under strata of the soil, by means of auger and testing rod, is a necessary preliminary to the location of any and all drains. Deep drains only are efficient. While subsequent treatment by means of washing and special crops is required to restore lands which have become highly charged with alkali, drainage alone, with some special irrigation and judicious cultivation, will quite frequently restore the land to its original productiveness in one or two years. Where alkaline conditions do not prevail the restoration is marked and immediate.

COST OF DRAINING IRRIGATED LANDS.

By means of the investigations of the Department carried on in cooperation with landowners in several States, the practicability of draining lands of this class at a reasonable cost has been shown and is now admitted where experimental work has been done. It is estimated that there are not less than 725,000 acres of irrigated land which has become seeped and is susceptible of drainage. The cost of draining the land will be $15 to $25 per acre. It is located in the older irrigated centers and is furnished with paid-up water rights, and will easily be worth $100 an acre when reclaimed. Basing estimates on this price and on a cost of draining of $20, the net gain in value brought about by drainage would amount to $58,000,000. In view of these conditions and facts, farmers who own lands of this class can better afford to reclaim than to abandon them, or, as is frequently done with the lands less seriously injured with water, to use them for salt-grass pastures.

DRAINAGE IN HUMID REGIONS.

The Department is actively promoting the drainage of wet lands throughout the humid regions of the United States. Examinations of such lands, followed in many cases by the preparation of definite plans for their drainage, have been made in twenty States during the year. Large areas are now being reclaimed in accordance with the Department's plans. Special studies have also been made of the methods for reclaiming turf and peat lands in the Northern States and for draining the salt marshes of the Atlantic coast.

OFFICE OF PUBLIC ROADS.

The Office of Public Roads has continued the work of aiding road improvement by studies, experiments, and object lessons. Proper construction and maintenance of public highways engages public and official attention to a great extent, and the Office of Public Roads has proven its usefulness to the general public more emphatically than ever before. The adoption of state aid in the construction of public roads by more than half the States and the consideration of the question by the remainder, together with large bond issues by many counties, are indexes of the general interest being shown in the work, and have occasioned a great demand upon the Office for advice and assistance. These have been given to the fullest extent compatible with the resources of the Office, and have brought about more active cooperation and larger material results than ever before.

OBJECT-LESSON ROADS.

During the past year especial attention has been given to object-lesson work. Of the total appropriation of $87,390 made for the Office, $16,916.79 was expended in carrying out demonstrations on 69 sections of road, with a total surface area of 661,992 square yards, as against $17,908.25, expended on 31 sections, with a total of 223,208 square yards, during the preceding year. These operations covered 12 macadam, 26 sand-clay, 7 gravel, 10 earth, 1 shell, and 15 experimental roads. The experimental roads consisted of 8 sand-clay, 1 burnt clay, and 6 roads in which oil or asphaltic products entered as binder. The purpose of these object-lesson roads was to give elementary instruction to local road builders and to demonstrate the possibilities of road improvement. They were built under cooperative arrangements by which the local authorities paid all expenses of machinery, labor, tools, and materials, the Government providing for the engineering work. So effective has been this phase of the educational work of the Office that the number of square yards constructed has grown from 79,203 in 1905 to 661,992 in 1909.

The policy of the Department in this work leads neither to extremes of conservatism nor radicalism, but toward pointing out the most profitable use of material and means at hand in a given locality. In pursuing this policy communities with abundant resources have been encouraged to use them more freely, and thinly settled regions have been protected against results of enthusiasm for expensive roads, and materials have been proven available which, until recently, had been regarded as of little value.

EXPERIMENTAL WORK.

Second in importance only to object-lesson work is the experimental work of the Office. The most important problem considered has been that of preventing the destructive action of automobile traffic on costly macadam roads. In working out this problem experiments have been made to secure satisfactory binders and dust preventives within reasonable cost. Excellent results have been attained in the use of asphalt, tar, and other bituminous binders, waste from sugar refineries and wood-pulp mills, and other by-products. It was largely to consider this question that the greatest road convention ever held was convened at Paris, France, in which

29 countries participated, the Director of the Office of Public Roads being chairman of the commission of three representing the United States.

Especial attention has been given to experiments with blast-furnace slag—alone and in combination with other materials—in the construction of roads, to find a way to utilize the large quantities of this waste material available.

The sand-clay road has been found so satisfactory in the South that it has been introduced into several of the Western States, notably Iowa, Kansas, and Nebraska. The construction of such roads is expected to prove of great value in the trans-Mississippi States.

During the year 185 lectures were given by representatives of the Office of Public Roads in 29 States, as against 200 lectures the preceding year. This decrease was not due to any lack of demand for this character of assistance, but rather to the necessity of withdrawing engineers from the lecture platform to supervise object-lesson work. These lectures were not given for entertainment, but to educate those who have to do with the construction of roads and the administration of highway affairs.

In the experimental work of the Office, that on the corrosion of iron and steel has been continued with favorable results. This work was inaugurated to find means of lessening depreciation in iron and steel culverts in road work, and was later extended to fence wire. Upon the findings of this Office a number of manufacturers have installed improved methods of manufacture which promise to remove many of the difficulties heretofore encountered.

The advisory work of the Office, aside from object-lessons and lectures, comprises the introduction of model systems and special advice and inspection. The work with model systems involves assignments under which an engineer of the Office examines the entire road system of a county, its road materials, and other phases of the public-road situation, and makes a detailed report, with advice as to best methods and materials. Five counties have been so assisted during the past year. Assignments for short periods have been made for aiding in the solution of local problems in 142 cases.

An attractive and instructive exhibit was made at the Alaska-Yukon-Pacific Exposition at Seattle by the Office, the details of which were described in a small handbook.

COOPERATION WITH OTHER BUREAUS, ETC.

The Office of Public Roads cooperated with the Forest Service in the location of trails; with the U. S. Geological Survey and the geological surveys of several States in the investigation of road materials; with the American Society for Testing Materials in standardizing tests for road materials; with the Post-Office Department in the inspection and improvement of rural delivery roads; with state experiment stations in devising ways and means for joint work; with the Isthmian Canal Commission in tests of materials; and with state highway officials and various scientific societies.

ENGINEER STUDENTS.

The demand for skilled road engineers shows no abatement. The success attending the instructions given in the Office of Public Roads has led to an investigation of the status of highway engineering in various technical schools and colleges. It was found that greater attention is given to this branch of engineering than heretofore. The policy of appointing engineer students in the Office of Public Roads has been continued with good results. Under this policy a limited number of young men with engineering training are appointed at small salaries and, after a course of thorough instruction in highway work, are advanced to the position of assistant engineer and given practical work in the field. The success of the plan is demonstrated in the increased drafts on this corps for state and municipal work.

Summing up the results of the year, it may be safely said that the work of the Office of Public Roads during the past year has been more successful than ever before. It is not intended to make any material changes in the general plan of the work during the current year.

SALARIES OF SCIENTISTS.

There is a provision of law pertaining exclusively to this Department which limits to $3,500 the annual compensation which may be paid from the lump fund appropriations to any scientific investigator in the city of Washington, or other employee engaged in scientific work. Many of the lines of work carried on by the Department of Agriculture require the direction of men of high scientific attainment, and as these men, particularly after years of additional training and experience in Department work, can command much higher salaries outside of the government service, it is with difficulty that the Department of Agriculture is able to retain them. I have therefore recommended to Congress, in the estimates for the fiscal year ending June 30, 1911, that this maximum salary be increased from $3,500 to $4,000, not, however, with the view of a general advancement of this class of employees, but rather for the purpose of recognizing the services of those few who signally distinguish themselves in the Department by extraordinary scientific discovery or invention inuring to the especial benefit of the agricultural and kindred interests of the United States. The Department has already lost many of the ablest members of its corps of scientists, who have been tempted by more attractive offers from the outside, and these losses will undoubtedly continue to occur unless Congress, by increasing to $4,000 the present legal limitation, permits the Secretary of Agriculture this latitude in fixing the compensation of the various members of his scientific staff.

FIELD DIARIES.

In connection with the gathering of agricultural statistics, farm demonstration work, soil survey work, meat inspection, enforcement of the Food and Drugs Act, administration of the National Forests, and numerous other lines of scientific investigation prosecuted by the Department of Agriculture and involving field service, a great many agents are employed who travel more or less constantly at government expense. The itemized expense accounts of such officers are carefully audited before being paid by the Department, but with a view to having an even closer supervision of expenditures of this character and the necessity therefor, each traveling employee is now required to keep a field diary and enter therein a comprehensive summary of his official acts from day to day. This diary is subject to the inspection of both the administrative officer of the Bureau concerned and the disbursing officer of the Department; the former is thereby enabled to determine whether items of expense incurred were in all cases necessary in connection with the performance of the duties required of the traveling employee, while the latter finds the record of direct value in the audit and administrative examination of the expense account when submitted for payment.

CONSOLIDATION OF WORK.

In the act making appropriations for the Department of Agriculture for the fiscal year 1909, Congress appropriated $25,000 for the construction of a building to be used for stables, storage purposes, and the consolidation in one shop of the various lines of mechanical work conducted by the different branches of the Department. This building, known as the mechanical shop building, has been completed, and all repair work is now centralized under one roof with considerable saving of labor and expense. With a view to further simplifying the work and making for economy, I have, in the estimates for 1911, transferred to the contingent fund, from the appropriations for the several Bureaus, Divisions, and Offices, certain sums of money proportional to the repair work on buildings and office fixtures done for them, and such amounts as they may severally require for incidental expenses in the city of Washington, such as fuel, electric light, gas, ice, etc., and it is recommended that the Congress enact this suggestion into legislation and that the contingent fund of the Department be increased accordingly. Also during the fiscal year 1909 all watchmen and charwomen were transferred to the roll of the Office of the Secretary, thus centralizing, under the supervision of the Chief Clerk of the Department, all employees engaged in the preservation of buildings and grounds. In view of the large area of the reservation occupied by the Department, the many buildings thereon, and the many buildings rented in the immediate vicinity, such a concentration of the mechanics, watchmen, and charwomen had become imperative and would have been accomplished at an earlier date had the shop building been available.

I have endeavored in the foregoing report to call attention to the work of the Department during the past year in all its Bureaus, Offices, and Divisions. The new responsibilities laid upon us have been met with fidelity and with what ability we possess. We are helping the farmers of all sections of the country and the isles of the sea, and results are becoming evident. The soil is responding to better methods and more suitable plants, the farm income is increasing, farm education is making the rural home more attractive, each locality is becoming more useful to the others, each specialty more necessary to the others. Abundance contributes to happiness—people of the several States are learning to know each other better and love each other more.

Details of the work of the Department are contained in the accompanying reports of the various Bureaus, Divisions, and Offices, the publication of which in connection with this report is respectfully recommended.

Respectfully submitted.

James Wilson,
Secretary.

Washington, D. C.,
November 20, 1909.

REPORTS OF CHIEFS.

REPORT OF THE CHIEF OF THE WEATHER BUREAU.

U. S. Department of Agriculture,
Central Office of the Weather Bureau,
Washington, D. C., September 10, 1909.

Sir: I have the honor to submit a report of the operations of the Weather Bureau during the fiscal year that ended June 30, 1909.

Willis L. Moore,
Chief of Weather Bureau.

Hon. James Wilson,
Secretary of Agriculture.

RESEARCH OBSERVATORY AT MOUNT WEATHER, VA.

The Sixtieth Congress at its first session authorized the rebuilding of the administration building, destroyed by fire in October, 1907, the construction of a central heating and power plant, and the completion of the physical laboratory and the cottage and office building. The details of progress in construction are given elsewhere.

A part of the office force moved into the physical laboratory building early in March. The principal instruments and machinery for the large workroom have been installed and the greater number of instruments and apparatus for the laboratory have been ordered. Some smaller apparatus have already been received.

As the central heating and power plant and the cottage and office building are located in the uncleared part of the reservation, the roads had to be extended to include those as well as the physical laboratory. In all, 1,200 feet of roads were constructed, and about 2,000 tons of bowlders and smaller stone were removed from the grounds in connection with grading and road making.

SCIENTIFIC WORK.

AERIAL OBSERVATIONS.

The investigation of the lower layers of the atmosphere by means of kites and captive balloons has been continued throughout the year. Observations of temperature and moisture of the air in a vertical direction, the changes in the speed and direction of the air currents, and the approximate depth of layers of fog and cloud were made daily, except Sundays. The average altitude attained by kites during the year was 2,663 meters (8,737 feet) above sea level; by balloons, 2,004 meters (6,575 feet). The corresponding heights for the previous year were: For kites, 2,388 meters (7,835 feet); for balloons, 1,738 meters (5,702 feet). The height attained by the kites last year, though greater than for the previous year, is somewhat below the ideal altitude for observations in the lower layers of the atmosphere; that is, between the ground and 2½ miles altitude.

Flights up to and above that altitude are obtained so irregularly as to be of much less value than were they more regular and consecutive. The drift of the air currents is such that it may be impossible for two weeks at a time to get a kite through the zone of still air that overlies the mountain and adjacent valleys. Then, without any preliminary indication, the lower 3 miles of atmosphere will move as a whole with something like uniform speed, and the altitude to which the kites may be sent is a question largely of the strength of the wire and the containing drum.

While the present form of kite is satisfactory for general use, a kind is needed that will withstand the conditions imposed by fog and rain. In a great many cases, probably 100 a year, the mountain is enveloped in fog. Under these conditions the kite sails rapidly take up moisture. This increases their weight, while the shrinking due to the wetting of the fabric often causes the sticks to break, and the kites are precipitated to the ground. Effort has been made to secure material for sails that will not absorb water.

The use of a better quality of material in the constructing of captive balloons has resulted in a greater altitude being reached, and a further increase in the average altitude reached is confidently expected during the coming year.

The kite and balloon observations have been regularly published in the Bulletin of the Mount Weather Observatory, a publication almost wholly devoted to the meteorology of Mount Weather.

SOLAR RADIATION.

Measurements of the intensity of solar radiation and the polarization of sky light have been made at Washington and Mount Weather whenever conditions were favorable for this work. At Washington 56 series of observations were obtained, 32 of which appeared to be good enough to justify their employment in computations of the solar constant. At Mount Weather, out of a total of 27 series of observations, 8 were employed in solar-constant computations. The results have been prepared for publication in the Mount Weather Bulletin.

During the past year observations were obtained on a greater number of days than in the year preceding. They indicate a greater intensity of solar radiation at the surface of the earth and a greater percentage of polarization of sky light than was found during the year ending June 30, 1908, which appears to have had a low value for both sky polarization and solar radiation.

The international commission for securing daily weather reports for the globe has recently included a measurement of the intensity of solar radiation in the list of meteorological observations to be telegraphed daily from selected stations located about the centers of action of the atmosphere. This is indicative of the interest now being taken in the relation between the intensity of solar radiation at the surface of the earth and weather conditions. Recent literature also shows an increased interest in the relation between the polarization of sky light and weather conditions, and the Mount Weather Observatory will cooperate with several foreign observatories in an attempt to determine more definitely the exact nature of this relation. In a paper by Professor Kimball, in volume 2, part 2, Bulletin of the Mount Weather Observatory, it is shown that a relation exists between the polarization of sky light and the transmissibility of the atmosphere for solar radiation. It appears, therefore, that the intensity of solar radiation at the surface of the earth, sky polarization, and weather conditions are phenomena whose relations should be carefully studied.

Extension of this line of research has been retarded by unavoidable delays in obtaining suitable apparatus. Angström pyrheliometers deteriorate with age, and much difficulty has been experienced in replacing defective parts. It has therefore become necessary to devise an instrument that can be manufactured in this country. As stated in my last annual report, such an instrument has been devised in our Instrument Division, embodying some principles not heretofore employed in pyrheliometry. Samples have been tested and defects remedied, and the evolution of a pyrheliometer that will be easy of manipulation and accurate in its indications appears to be in satisfactory progress. With its completion it is hoped to inaugurate an active campaign having in view the study of the intensity of solar radiation in different sections of the United States.

MAGNETIC OBSERVATIONS.

At the close of the calendar year 1908 the computation of the hourly values of declination and of horizontal and vertical intensity was temporarily abandoned, as were also the photographic records being made by all the larger instruments. A record of the declination and the horizontal and the vertical force was continued, however. This record has been approximately checked by absolute values obtained from eye readings, and is intended to serve the needs of the future. Data of magnetic storms, auroras, and sun spots have also been collected for publication.

NEW WORK PROPOSED.

During the coming year it is proposed to increase the value of kite and balloon flights by making them every day. The first Sunday flight was made July 19, 1909. Two years of active work with kites and captive balloons at Mount Weather have shown that the records thus obtained should be supplemented by others from higher regions of the atmosphere than can be reached with kites, captive balloons, or even manned balloons. Such can be secured by the use of free balloons, or, as sometimes called, "sounding balloons," developed principally by De Bort in France and Assmann in Germany. Kite flights in the center of storm activity are made with considerable difficulty, owing to the unsteadiness of the wind and the increased weight of the kites when wet with precipitation. Preparations are now under way to send expeditions from Mount Weather to two western stations, for the purpose of liberating free balloons simultaneously at the two points—one in or near the storm center and the other some hundred miles to the eastward. The station at Mount Weather can not be used, owing to its proximity to the sea. Some of the free balloons sent up by Professor Rotch at St. Louis landed 250 miles to the eastward of that city.

Another method of studying the changes in the atmosphere in a vertical direction is that afforded by mountain stations. During the coming year it is proposed to secure a continuous record of the temperature and possibly of other elements at high stations in Nevada and Colorado. While the temperature of the free air is not quite the same as that on a mountain top at the corresponding elevation, the differences are small. Moreover, the mountain temperature record will afford valuable information as to the propagation of temperatures upward or downward due to a horizontally flowing current of definite thickness. Kite observations at Mount Weather have shown at times the existence of a warm horizontal air current on the mountain top nearly twenty-four hours before it appeared in the valley about 300 meters (1,000 feet) below.

Since the foregoing was written preliminary returns have been received from the two sounding balloon parties that it was proposed to send out from the Mount Weather Research Observatory.

Eight ascensions were made, in each of which the altitude attained equaled or exceeded 10 miles. On October 12, at Omaha, Nebr., a height of 15 miles, hitherto unprecedented for this country, was attained, and on October 6, at Indianapolis, Ind., a height of nearly 14 miles was reached. The last-named ascension was made in almost the center of a great area of high pressure. The balloon was observed to move in a southwesterly direction at all altitudes, and was later found in that direction about 30 miles from the city. A similar movement—that is, a drift of the air at high altitudes toward the southwest—was observed at Omaha, Nebr. This would seem to indicate that the control of the general atmospheric movements exerted by areas of high pressure extends upward to greater altitudes than has been hitherto suspected.

In general, the results of the ascensions, so far as available, are in close accord with European observations. The great isothermal layer was reached on eight occasions; its lower limit varied greatly in altitude from day to day and for different surface weather conditions.

FORECASTS AND WARNINGS.

Upper air observations have been telegraphed daily from Mount Weather to Washington and utilized in the preparation of the official forecasts. Observations secured at elevations of 8,000 to 10,000 feet and higher have permitted a determination of temperature gradients and normal and abnormal wind currents that bear a definite relation to subsequent weather changes in the Middle Atlantic States. For instance, it has been found that the average wind direction at Mount Weather at about 10,000 feet above sea level is northwest, and that shifts of wind to west and southwest usually forerun by about two days the beginning of rain on the middle Atlantic seaboard. Continued observations and careful studies thereof will doubtless reveal many upper air indications of positive value in practical weather forecasting.

Isobaric charts based upon telegraphic reports received from selected stations throughout the Northern Hemisphere have been prepared daily, and forecasts for about a week in advance have been issued at intervals for publication. The following illustrate the character and scope of these forecasts:

Thursday, July 9, 1908:

A warm wave that will cover the Plains States Friday will extend over the central valleys Saturday and set in over the Atlantic States Sunday. The warm period will be of two or three days' duration in the several sections, and will end with rains in the Plains States on Sunday, in the Mississippi Valley and western lake region on Monday, and in the Ohio Valley, the eastern lake region, and the Atlantic States Monday or Tuesday. The rains referred to promise to be sufficiently heavy to end the existing drought in the Ohio Valley and Middle Atlantic States.

The warm wave was the most intense of the summer of 1908. Its progress and duration, and the movement of the rain and cooler area, conformed to the forecast.

On July 15, 1908:

A barometric depression that now covers the Rocky Mountain districts will move over the Plains States Thursday, cross the central valleys and lake region Friday and Saturday, and reach the Atlantic States Saturday night or Sunday, preceded by rising temperature, attended by local rains and thunderstorms, and followed by two or three days of fair and cooler weather. This depression will cause rains in the wheat and corn belt and also rather copious rains in the Ohio Valley and the Middle Atlantic and New England States.

The depression advanced as forecast, and generous rains fell in the corn and wheat belt. Rainfalls were also heavy in areas in the Ohio Valley and the Atlantic States north of Maryland and relieved the drought that prevailed in those sections. The depression was followed in the interior by two or three days of temperature below the seasonal average.

The Evening Metropolis, Jacksonville, Fla., of July 30, 1908, comments as follows regarding a tropical storm that advanced northward near the Atlantic coast:

The storm that the Weather Bureau has been watching for three or four days has at last shown itself, and this morning is approaching the coast line near Wilmington, N. C. At 7 a. m. the wind velocity at North Carolina stations was between 40 and 50 miles an hour from the east and northeast. No doubt the disturbance has been giving some sailing vessels a hard time. The fact that the storm has at no time been near land, and yet located daily with almost absolute accuracy, shows the exactness with which the Weather Bureau makes its predictions. There are a number of vessels that delayed sailing on account of the display of storm warnings, and they now appreciate the wisdom of their conduct. The Weather Bureau was established to render service. Who will say that it is not doing so?

The Virginia Pilot, Norfolk, Va., of August 2, remarks as follows regarding warnings issued in connection with this storm:

It was due to the magnificent work of the Weather Bureau that there were no wrecks along the coast. Many hours before the storm developed any great strength the Bureau had sent warnings along the coast to notify mariners that there was a blow off the Florida coast and advised caution about proceeding south. These warnings were sent to several wireless stations, which transmitted them to vessels at sea having the wireless apparatus, so that the news was flashed down the line.

The St. Louis Times of August 15 refers editorially as follows to weather forecasts in general, and to a forecast of August 13 in particular:

Close observers of weather conditions have noted in recent months that the department of meteorology at Washington has been indulging in some long-distance and wide-range forecasts.

Time was when the word chiefly employed by the forecasters was "Probably." Now there is a certain note of positiveness in the twenty-four-hour forecast, and the long-distance, wide-range bulletins amount almost to predictions. Several weeks ago, for instance, the department announced that a blanket of rain would begin at the Rocky Mountains and stretch to the Atlantic. The forecast covered a period of a week, gave great cheer to the agriculturist and business man generally, and was fulfilled exactly.

Yesterday the department made a prediction, technically called a forecast, covering a period of five days ending next Wednesday morning. All of the spring wheat and corn States are to have needed hot weather, followed by needed rain, after which it will be cooler. It will be worth while noting the outcome of this prediction.

If the department at Washington finds it possible to make a forecast covering the great growing section of the country for a week, it will have increased its usefulness immeasurably.

A special feature of a forecast issued on the 18th was a prediction of well-distributed rains in the cotton belt, where rain was needed. The rains occurred over the cotton belt as forecast, and in the Atlantic States the rains that set in were exceptionally heavy.

The following from the Daily Picayune, New Orleans, of August 26, 1908, indicates the demand for weather information that increases with recognition of the value of the forecasts:

The weather map issued by the United States Weather Bureau yesterday showed generally settled weather conditions over the greater portion of the country for the first time in several days. These conditions call attention to the special forecast issued by Chief Willis L. Moore, of the Weather Bureau, Tuesday, August 18, and published in the Picayune on the 19th. Looking over the weather map we see that the barometric depression referred to in the forecast crossed the Rocky Mountain districts on the 20th and 21st, the Plains States on the 22d, the central valleys and the lake region on the 23d and 24th, and is now over the Atlantic States. The well-distributed rains forecast by Professor Moore have fallen, and those sections of the cotton belt where rain was needed have received copious showers. The map issued Tuesday shows the comparatively cool and settled weather moving eastward just as forecast eight days ago. Forecasts of this character, when so fully verified as have been the case with the Weather Bureau forecasts, are of great importance to agricultural and commercial interests, and the public will look keenly for information telling a week or more in advance what weather to expect as they look for the daily forecasts covering a period of thirty-six to forty-eight hours. Commercial interests attach such importance to the forecast that request has been made that such forecasts be telegraphed as soon as issued, at the expense of the recipient.

A remarkable period of dry weather set in over the northern half of the United States east of the Rocky Mountains during the latter portion of August and continued well into the third decade of September. In two or three instances during this period indications that as a rule presage rain partially or wholly failed. The rather remote causes of the dry spell are now recognized. It was not possible to detect and interpret them with previous imperfect knowledge of the operative influence of the greater barometric areas.

On September 22 the following forecast based upon radical changes in pressure was issued:

A barometric disturbance will cross the country from about the 24th to 28th, attended by rains that will set in over the central valleys about the close of this week and extend over the Atlantic States by the beginning of next week. Following the rains there will be a sharp fall in temperature, with frost in the central valleys and Eastern States north of the fortieth parallel.

The rains that attended this disturbance occurred as forecast and relieved the drought in northern and northeastern districts. The frosts that followed its passage extended over the Middle Western States and the States of the Ohio Valley and middle Atlantic coast.

The following comment on this storm and cool wave is made by the Market Growers' Journal, Louisville, Ky., of September 30, 1908:

> A general area of rain set in over practically the entire Rocky Mountain region the latter half of the week and moved gradually eastward, bringing rain to the Mississippi Valley States by Saturday night. The rain reached the Ohio Valley Sunday night of this week and the indications at this writing are that before this issue reaches our readers the drought in all sections of the country which have been suffering will have been brought to an end. An interesting fact of this rain period is that it was predicted early last week in a bulletin sent out by the Weather Bureau at Washington * * *. The general rains, which marked the end of the drought, are being followed by a period of cold weather which will mark the end of the unusually warm weather of September.

An editorial in the Albany, N. Y., Journal of September 29 reads as follows:

> Just now there is in evidence the fulfillment of a forecast made a week ago. Early last week it was announced from Washington that conditions were favorable for the development of a general rain area in this part of the country by about the 28th instant. Because of the long absence of rain, that prediction was of unusual interest, and the arrival of the time appointed for its fulfillment was waited with mingled hope and apprehension.
>
> There was a widespread feeling of relief when the sky became overcast and precipitation began, gradually, as it nearly always does after a long period of dry weather.
>
> The Weather Bureau is to be congratulated upon the accuracy of a "long-distance" forecast, made at a critical time when all ordinary signs, even to that old standby, the sun's "crossing the line," seemed to fail.

The Kansas City, Mo., Star of September 27 remarks as follows:

> An interesting fact about the storm area that is now moving across the country is that it was accurately predicted by the Weather Bureau last Tuesday evening (September 22), when a "long-distance" forecast was put out saying that rains would fall in the central valleys about the close of this week, and in the Atlantic States at the beginning of next week, followed by frost north of the fortieth parallel.
>
> The Weather Bureau's forecasts for a week ahead are still in the experimental stage, but they promise to be of great value. They are based on reports of barometric pressures in various parts of the world, indicating the progress of storm areas. Last Tuesday's forecast was based on reports of low barometric pressure at the time in Nome and Sitka, Alaska, and in Honolulu. But the present storm area first appeared over the Rocky Mountain regions with a bank of high barometer all week along the Pacific coast, so that it seemed questionable as to whether it came from the conditions on which the Weather Bureau based its long-distance forecast of last Tuesday.

The forecast was based on reports for several days preceding the date of its issue. On September 17 Pacific pressure was high over Honolulu and low over Nome. Three days later pressure was high over the Bering Sea region and low over the Hawaiian Islands. It has been observed that pressure changes over the Pacific Ocean forerun by several days certain changes on the Pacific coast and the American continent as a whole. On September 23 a decided fall in the barometer occurred over the middle and south Pacific coast districts, and on the following day the barometric disturbance appeared, as stated, over the Rocky Mountain districts. It is true that pressure continued high over the north Pacific coast. That was expected. The predictions are based, not necessarily upon the progress of individual storm and high barometric areas, but upon a study of atmospheric conditions over the whole Northern Hemisphere and more directly, at this season of the year, on the general circulation of the atmosphere over the Pacific and Atlantic oceans. In winter the great continental areas of high barometer, and more especially the Asiatic high area, appear to dominate the general atmospheric changes of the Northern Hemisphere. By a study of the association and interrelation of the greater areas of high and low barometric pressure, the forecasting of weather changes for a week or more in advance is made possible.

During the last seven days of September a hurricane advanced from the Lesser Antilles of the West Indies to the Great Bahama Bank. On October 1 the vortex of the hurricane recurved northward over the western Bahamas. The following notes regarding this storm are from the Nassau Guardian, New Providence Island, Bahamas, of October 3, 1908:

> The first intelligence that another hurricane had made its appearance reached us late last Saturday (September 26), when we were informed by cable from Washington that a storm was central near and south of Porto Rico, moving west-northwest. This information was confirmed by telegrams from the same source dated the 28th, 29th, and 30th, stating that a hurricane was central near the Great Bahama Bank, moving west-northwest. These statements were entirely borne out by the weather here on September 30, which throughout the day wore an exceedingly threatening aspect. * * * By 8 a. m. of October 1 the barometer had fallen to 28.88 inches, while the wind, southeast, had risen to an estimated velocity of 80 miles an hour—estimated, because at 7.45 a. m. the wind-recording instruments at the observatory were blown away. At this time squall succeeded squall with rapidly increasing velocity from the southeast, the rain falling in continuous torrents, being driven by the wind with a force that the few adventurous persons who were out found positively blinding. * * * Although much damage was done on land, interest centered on the shipping in the harbor, most of which was in sore straits. * * * At 10 a. m. the barometer reached a minimum of 28.68 inches, with wind from the south blowing at an estimated velocity of 60 to 80 miles an hour. At noon the barometer had risen to 29.10 inches.
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> * * * * * * *
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> An instance of the value of the storm telegrams is afforded by information obtained from Mr. William Hilton, who arrived this morning from Staniard Creek. He states that a great many of the sponging craft there had been launched and taken out of the creek to the north side, but that on the receipt by the Rev. Mr. Dinsdale, on Sunday night, of a copy of Saturday's storm telegram, sent by the port officer, the vessels were all brought into the creek again and secured. Had this not been done the damage to shipping there would probably have been very great.

The telegrams referred to were sent by the Chief of the Weather Bureau to the governor of the Bahamas, Nassau. They were begun September 26, 1908, and advised measures to protect shipping.

On Tuesday, October 20, the following general forecast was issued:

> The barometer has fallen rapidly over the southern Rocky Mountain region, and a well-defined storm will appear in that section Wednesday morning. This storm will move northeastward, attended by rain in the central valleys Thursday and in the Atlantic States Friday or Saturday. The rains promise to be sufficiently heavy to extinguish the fires in the Allegheny and Adirondack mountains.

The rains set in as forecast, and in the eastern mountain districts, where forest fires were destroying property, they continued several days.

The following are among many comments that were made by the press regarding warnings issued in connection with a severe cold wave that swept the country from the Rocky Mountains to the Atlantic during the first decade of January, 1909:

Kansas Farmers' Star, Wichita, Kans., January 8, 1909:

> The weather man gave the farmers of the Southwest plenty of warning. There can't be any very good excuse for not having provided shelter for their live stock.

Market Growers' Journal, Louisville, Ky., January 16, 1909:

> * * * This cold wave was forecast in a special bulletin sent out by the Weather Bureau Saturday afternoon, January 2. This forecast indicated the coldest weather of the season for States east of the Mississippi River, and was issued in ample time to warn all growers who needed the warning. * * *

Post-Express, Rochester, N. Y., January 5, 1909:

> * * * Hundreds of shippers are holding back shipments on warnings from the Weather Bureau, and many shipments were rushed following the warning sent out last week. The absolute accuracy of the two special forecasts made by the Weather Bureau at Washington has aroused much favorable comment among business men here and in some instances has saved thousands of dollars for nurserymen and brewers.

Daily Times-Union, Jacksonville, Fla., January 11, 1909:

> * * * The point of interest involved in the forecast is the fact that nine days ago the Washington office announced the existence of conditions that favored cold-wave formation, and on Monday and Tuesday the same office gave notice that the cold wave actually existed in the Northwest and that the extreme cold would reach the seaboard States during the last of the week, which was exactly the case, for on Friday the temperature in the middle Atlantic section was about 15° above zero and freezing prevailed over the south Atlantic section.
>
> The merit of such long-range weather predictions lies in the fact that they enable shippers to meet contingencies; for instance, the Florida shipper of fish knows that no reicing will be necessary, and the banana shipper from Mobile and New Orleans provides the necessary warmth for his cars. Other commodities to interior points are given the necessary attention.

The Times, Tampa, Fla., of February 1, 1909, refers editorially as follows to warnings issued in connection with this cold wave:

> The Weather Bureau gave ample warning, so that persons who desired and were prepared could "fire" their groves and shelter their seed beds and avoid any loss whatever. The value of the Bureau is made more evident every year by the saving it enables people to make in defending themselves against cold and storms.

The following special forecast was issued on Saturday, February 6, 1909, in connection with a storm that advanced from the Pacific to the Atlantic coast from the 6th to the 10th:

> A storm that now occupies the north Pacific coast will move southeastward over the Rocky Mountains Sunday, and then eastward over the Plains States Monday and Tuesday, and reach the Atlantic coast about Wednesday, attended by snow in middle and northern districts, and followed by a cold wave that will appear over the Northwestern States Sunday or Monday, advance over the central valleys and Lake region Monday and Tuesday, and reach the Atlantic States about the middle of next week.

The following are among the press comments that have been made regarding this forecast:

The Times, Fort Smith, Ark., February 8, 1909:

> On Saturday there was sent out from the Washington Weather Bureau headquarters a general forecast, reporting a storm disturbance on the northern Pacific coast that would advance southeast, followed by a cold wave. They made good. The Monday morning chart indicated that the storm advanced over the Rocky Mountain region, accompanied by snow or rain, which covered the whole Mississippi Basin. Following it, an area of high barometer is sweeping down from the north, accompanied by a fall of as much as 36 degrees in temperature. * * *

Courier-Post, Hannibal, Mo., February 9, 1909:

> * * * The storm is the one predicted from the Washington Weather Bureau as early as last Saturday, and the prediction has proved remarkably accurate for such a long time ahead. It is central to-day over Iowa, where it is very pronounced. Heavy snows are predicted for the northwestern part of the State, and strong gales. The zero line has been pushed down into northern Kansas. * * *

Commercial Tribune, Cincinnati, Ohio, February 11, 1909:

> Within a few days the Weather Bureau has come up to all expectations. As early as last Monday the signs indicated rain and snow, and Tuesday morning we were told to look out for rain, snow, and much colder weather on Wednesday. Everything came to pass. The reason for calling attention to this fulfillment of prophecies grows out of the fact that there are countless thousands who find fault whenever there is a little slip up. As a rule, the predictions are quite accurate and there has been a distinct improvement over other years. In short, the business is beginning to rest more nearly upon a scientific basis, and improvements and observations which are to be expected in the future will make this branch of the Government one of the most important, not to the few, but to many millions. * * *

The following special forecast was issued Sunday, March 14, 1909:

> During the present week a disturbance will advance from the Pacific to the Atlantic coast from about Tuesday to Friday, preceded and attended by rising temperature and by general rains in the middle and southern districts and by snow in the more northern States, and followed by a period of cooler, fair weather that will set in over the Northwestern States Tuesday night and reach the Atlantic seaboard about the close of the week.

The disturbance referred to appeared Tuesday, the 16th, over the Pacific States and its center reached the Atlantic coast Friday night, the 19th. Its passage was attended by snow from the Missouri Valley over the Lake region, and by rain from the lower Mississippi and Ohio valleys over the Southern and Southeastern States. It was followed by lower temperature, that set in over the Northwest Tuesday night and reached the Atlantic and east Gulf States Saturday.

On April 7, 1909, the following special forecast was issued:

> Several days of comparatively cool weather are indicated for the eastern half of the United States, with frost in the middle and upper Mississippi and Ohio valleys and the Lake region, and thence over the Middle Atlantic and New England States. Frost is also likely to occur in the interior of the Gulf and South Atlantic States.

Following the disturbance of April 5 to 8 an area of high barometer swept south and east from the British Northwest Territory, attended by frost-bearing temperatures that reached the Gulf States the morning of the 9th and covered the east Gulf and Atlantic States the morning of the 10th. On that date frosts were general in the South, including northwestern Florida, and on the morning of the 11th a minimum reading of 26° was noted at Washington, D. C.

On April 21, 1909, a warning of freezing temperature was issued for Colorado, and on the morning of the 23d temperature fell to 27° at Pueblo and in the Arkansas Valley. The Star-Journal, Pueblo, Colo., of April 23, 1909, comments as follows regarding the frost:

> The Weather Bureau predicted the frost more than twenty-four hours ahead, and every effort was made to give warning to the farmers. Almost without exception fruit growers whose crops were endangered heeded the warning of the Weather Bureau and protected every early-blooming fruit tree with plenty of smudge fires, and so prevented any loss by frost.

The Record, Fort Worth, Tex., of May 5, 1909, refers editorially as follows to action taken by Colorado fruit growers to protect their crops from the cold wave of April 30–May 1:

> There was an illustration in Colorado last week of how man's ingenuity combats the elements and sometimes thwarts the full workings of nature. Colorado fruit growers had been warned of the coming of the cold wave which there was every evidence to believe would blast the fruit crop. The fruit crop in the threatened Grand Valley is estimated to be worth $3,000,000. Fruit growers immediately got busy with the smudge pot. These oil heaters performed the miracle of heating the whole out-of-doors. The danger point to the fruit crop is 28°, and the smudge pots pushed the thermometer register up to 32°. The orchards were saved. The cost of equipment was an average of $25 an acre, the cost of running $5 a night, and the estimate is that not more than three nights a year would such precautions be necessary; hence at a cost of $40 there was saved each acre's crop, the value of which runs from $300 to $2,000.

New stations in Alaska.—Provision has been made for the establishment of three additional stations in Alaska (Eagle, Tanana, and Valdez), daily telegraphic reports from which are calculated to be of value in foreseeing the approach toward our northwestern borders of severe cold waves that have their origin over the far British northwest.

The application of upper air and world-wide surface observations to the art of weather forecasting for short and long periods is each year becoming more apparent, and progress along lines of useful forecast work will keep pace with discoveries that may be made in these practically unworked fields.

THE KEY WEST HURRICANE OF OCTOBER 11, 1909.

During the hurricane season of 1909 the weather was unusually stormy over the Gulf of Mexico and western Caribbean Sea. The first important storm of the season struck the Texas coast south of Galveston, the next two crossed the west coast of the Gulf of Mexico near the mouth of the Rio Grande River, and the fourth advanced northward over Louisiana. The Key West storm moved from a position over the south-central Caribbean Sea northwestward to extreme western Cuba from October 6 to 10, and there recurved sharply to the northeastward over Pinar del Rio Province, Cuba. At 11.30 a. m. of October 11 the vortex of the storm passed over Sand Key with barometric pressure 28.37 inches, and at 11.45 a. m. it passed Key West with minimum pressure 29.50 inches. Moving thence northeastward over the northern Bahamas the storm center passed northwest of Bermuda during the 13th and reached Newfoundland on the 14th, with a gradually expanding area and a rapid loss of tropical intensity.

Notices to shipping regarding this hurricane were begun October 6, when advices stated that a tropical disturbance over the central Caribbean Sea was moving west-northwest. On the 7th the storm advices stated that the disturbance was apparently approaching the Isle of Pines and developing intensity. On the 8th the center was located south of western Cuba and caution was advised to vessels bound for western Cuban waters. Advisory messages of the 9th followed the hurricane center on its northwest course, and on the 10th storm warnings were ordered on the southern Florida coast, and Atlantic and Gulf shipping interests were informed that the center of the disturbance was west of Habana, moving northwest by north and increasing in intensity. At 6 a. m. of the 11th storm warnings were changed to hurricane at Key West and Sand Key. This action was followed by the following special bulletin addressed to Atlantic and Gulf Weather Bureau stations and the press associations:

> The West Indian storm that has been moving westward over the Caribbean Sea during the last week has developed into a hurricane of marked intensity and at 8 o'clock Monday morning was central just west of Key West, Fla. At Sand Key the wind was 60 miles from the east. At 10 a. m. the pressure at Key West was 28.94 inches with a wind velocity of 56 miles from the east and a very high sea swell. Storm warnings were ordered Sunday afternoon from Key West to Mobile and changed to hurricane warnings early Monday morning. Hurricane warnings were also ordered on the Atlantic coast as far north as Charleston. The center of the storm will probably pass northward over Florida to-night and Tuesday and be felt Tuesday off the entire south Atlantic coast. All shipping in the affected area has been warned to seek refuge immediately. Hourly observations will be taken and all ports kept advised of the direction of the storm.
>
> MOORE.

In addition to the above the following was telegraphed to Florida Weather Bureau stations:

> Hurricane now central near Key West promises to be destructive to life and property over a large portion of the Florida Peninsula. You are authorized to incur any necessary expense and to adopt every reasonable measure to disseminate warnings to the islands, coast cities, and even the interior of the State.

Advices were issued during the day in which the northeast course of the storm was given and the statement made that there was apparently no further danger in the Gulf of Mexico. On the following morning the advices stated that the storm had passed northeastward over the Atlantic beyond the region of observation.

At 6 a. m. of the 11th the disturbance was central west by southwest of Habana, Cuba, and over or near the western portion of Pinar del Rio, and its advance over that Province was preceded and attended by torrential rains and winds of hurricane force. The storm struck Habana and raged for several hours, sinking or stranding small craft in the harbor and prostrating trees and wires and flooding the streets with water. The following are notes made by Mr. Dague, observer, Weather Bureau, during the passage of the storm over Sand Key, Fla.:

> By direction of the official in charge at Key West the office was deserted at 8.30 a. m., and the barograph and supplies were carried to the light-house. The signal tower fell at 8.45 a. m., and the sidewalk was carried away. A little later outhouses were washed away. When the station was abandoned the barograph had begun to fall rapidly and the wind had reached a velocity of 75 miles an hour. At 9.15 a. m. the anemometer cups were blown away, leaving only the cross arms. At 9.20 a. m. the top door of the roof was blown away. The wind at this time was estimated at 100 miles an hour, with gusts that exceeded that velocity. Heavy rain was falling, obliterating objects more than 50 feet distant. At 9.30 all trees had been blown down, the atmosphere appeared like a white mist, the island was becoming covered with water, and at 9.35 heavy seas swept over the island and a small cistern was blown over and carried to sea. At 9.45 a. m. the tower on the top of the station building fell, and by 9.50 the plank walks were entirely washed away. The large cistern was swept away at 9.52 and at 10 the entire island was covered with water to a depth of about 4 feet, all sand was washed from the island, and many of the steps of the building had been carried away. At 10.05 the foundation of the Weather Bureau building was nearly inundated and at 10.10 all the steps had been carried away. At 10.30 the building went over with a heavy crash

and was immediately washed out to sea. The boathouse was moved from its base.

A heavy swell from the southeast prevailed during the storm. The barometer fell rapidly from 4 to 11.30 a. m., when the minimum reading, 28.37 inches, was registered. A rapid rise then set in that continued until 6 p. m., at which time the weather had moderated. Excessively heavy rain fell until 1 p. m., when it began to decrease and ended at 2 p. m. After the wind had backed to the northwest the swell from the southeast opposed it and caused the water to spray from the top of the swells through the air with the wind. Two windows in the top of the light-house were blown out during the most violent part of the storm and caused a draft through the tower that made it impossible to open the door at the bottom of the tower.

At Key West the barometer at 8 a. m., October 11, stood at 29.42 inches, and fell rapidly to a minimum of 28.50 at 11.45 a. m. This is the lowest barometer reading ever recorded at that station. (See figs. 1 and 2.) The wind that at 8 a. m was blowing from the southeast at a rate of 30 miles an hour, shifted to east by 10 a. m., and at 11 a. m. had reached a velocity of 68 miles an hour from that direction. At noon the barometer had risen to 28.60 inches and the wind had changed to northeast and reached 72 miles. By 1 p. m. the wind had backed to northwest, and it continued from that quarter the balance of the day with velocities reaching 72 to 76 miles an hour until 4 p. m. The rainfall at Key West for the twelve hours ending 8 p. m. was 8.12 inches. Hundreds of buildings in Key West were wrecked by the hurricane and, so far as known, six persons were killed and many injured by flying débris. Many vessels were swept from their moorings and some of these were wrecked. The total financial loss in Key West is variously estimated at $2,000,000 to $3,000,000.

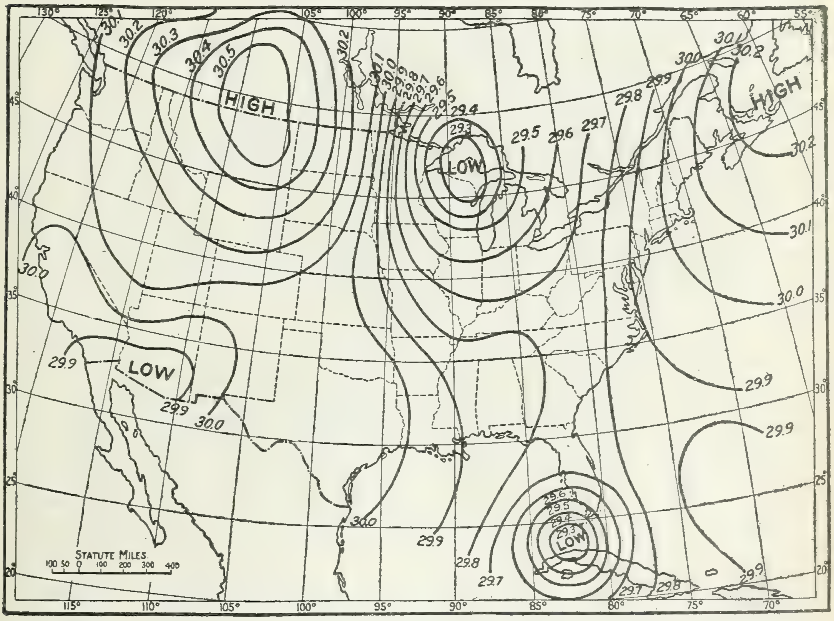

FIG. 1.—Isobars at 8 a. m., seventy-fifth meridian time, October 11, 1909.

After passing Key West the hurricane swept the Florida Peninsula south of Miami. North of Miami the storm was not severe. On the extension of the Florida East Coast Railroad about 3,000 workmen were withdrawn from dangerous points. J. P. Beckwith, vice-president of the line, states:

> Positively not a life was lost in the storm. Very little damage was done to the right of way or work on the extension. The road will be open to traffic within a few days to Knights Key. Warning by the Weather Bureau enabled us to fully protect all employees and equipment.

The hurricane loss between Miami and Key West is reported to have aggregated millions of dollars, and so far as known 11 lives were lost. Advices also show that the East Coast Railroad officials acknowledge that the Weather Bureau warnings were their salvation. Profiting from the experience of three years ago, when the lives of many men employed on the extension were lost and miles of track were destroyed, the men in charge prepared for the hurricane. The preparations thus made undoubtedly saved hundreds of lives. About Miami the principal damage was to the citrus crops, which were blown from the trees in immense quantities. At Nassau, Bahamas, the storm was felt the night of the 11th, when the barometer fell to 29.37 inches and the wind reached a velocity of 50 miles an hour from the southwest.

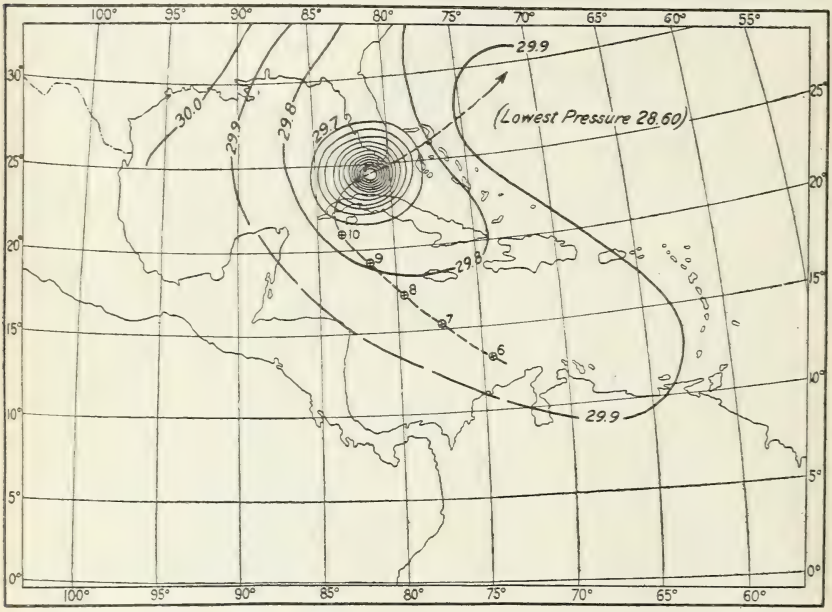

Fig. 2.—Isobars at noon, seventy-fifth meridian time, October 11, 1909.

While a summary of available information regarding this storm shows that protective measures employed upon the receipt of the warnings reduced losses of life and property to a minimum it appears certain that many fishermen, spongers, and others in small boats, and dwellers on the low-lying islands or keys that fringe the coast of the southern Florida peninsula that were outside the zone of communication were lost.

The storm of three years ago, above referred to, that struck the Florida keys with destructive force apparently originated over the eastern Caribbean Sea early in the second decade of October, 1906, and drifted westward as a shallow depression that covered practically the entire West Indian region. On the morning of the 17th the center of disturbance had reached a position south of western Cuba, where it recurved to the northeastward and passed near and east of Habana, Cuba, at 11.30 p. m. of that date, with minimum barometer at Habana, 28.86 inches. By the morning of the 18th the storm center had reached a position near and to the east of Key West, where at 3 a. m. a minimum barometer reading of 29.30 inches was registered. In its passage over Cuba the storm was of small diameter and great intensity, and caused great damage to crops in the Province of Habana. Crossing the Florida keys the barometer fell to 29.25 inches at Sand Key, with a maximum wind velocity of 75 miles an hour. At Key West the maximum velocity was 54 miles an hour. Although the warnings were given the widest distribution, much damage was done on the keys. The quarter boats of the East Coast Railroad extension were carried out to sea and many lives, probably more than 100, were lost. One hundred and fifty men were picked up at sea on wreckage. It is evident that under similar conditions the severe storm of October 11, 1909, would have caused a much greater loss of life than was caused by the storm of three years ago.

The following are among many newspaper references that have been made in connection with the Key West storm of October 11, 1909:

Editorial, New Orleans Times-Democrat of October 13:

> * * * The Federal Government has done all in its power to protect the people and the shipping by timely warnings of the approach of these storms. The Weather Bureau has been signally successful in these forecasts, being now able to follow a hurricane from day to day and give from five to seven days' notice of its coming, so as to enable all to prepare for it. But in spite of these warnings the storms find many persons unprepared and are able to do harm even when preparation has been made for their reception. * * *

Editorial, Boston Daily Globe of October 14:

> * * * Had it not been for the timely warning, hundreds of men undoubtedly would have been drowned along the route of that marvelous railroad, the creation of Henry M. Flagler and his engineers, which, when the last spike is driven, will bridge no less than 30 miles of open sea and cross at least 30 miles more of submerged keys and lagoons directly connecting Key West with the mainland of the United States.
>
> The Weather Bureau may make mistakes in some of its predictions (is bound to do so, in fact, in the present state of the science of meteorology); but when the Bureau makes good, it should receive due credit and praise.

Editorial, Washington Post, October 14:

> The tropical storm that wrought such havoc at Key West on Monday last might have been productive of much greater damage, especially to shipping, had not the Government Weather Bureau given timely notice of its approach. From its inception in the Caribbean Sea west of Jamaica on October 2 until it passed beyond the limits of observation ten days later, every stage of progress was heralded by daily advices and warnings.
>
> On October 10 an increase in intensity of the storm was reported to all interests needing information, and high winds were predicted for that night throughout central and southern Florida. The Weather Bureau observer at Key West hoisted hurricane warnings at daybreak the next day, some five hours before the fury of the storm was experienced, and ordered the Weather Bureau men at the vessel reporting station on Sand Key to leave their building

and take refuge in the light-house. This warning undoubtedly saved their lives, for the building was washed into the sea.

Until news could be obtained, much apprehension was felt concerning the large number of workmen at the construction camps of the seagoing railroad on the east Florida coast, but there was no loss of life. For this the company officials give all credit to the Weather Bureau, reporting that its warnings enabled them to protect the thousands employed on their extension works in that exposed section.

By such records as this the Weather Bureau establishes its worth and offers the best possible answer to its detractors. It may sometimes predict sunshine and give a rainy day instead, but it is at its best in foretelling these great storms. It is safe to say that the saving of loss of life and property resulting from its successful warnings in this one storm will more than compensate for its annual cost many times over.

RIVER AND FLOOD SERVICE.

The protracted drought of the late summer and autumn of 1908 over the watersheds of the great rivers of the eastern portion of the country practically insured immunity from disastrous floods during the following spring unless the rains of the winter and early spring should be more than usually abundant. Fortunately they were not excessive, although in early March conditions became very threatening along the Ohio River and great damage was done along the interior streams of central Kentucky.

The great floods of the year were those of August, in the rivers of the Carolinas and Georgia; of October, in eastern Colorado, Kansas, and Oklahoma; of November and December, in Oklahoma and Arkansas; and of January and February, in California. In South Carolina the stages of water were the highest of record, and the losses and damage in North Carolina, South Carolina, and Georgia amounted to $3,500,000. In Kansas, Oklahoma, and Arkansas the losses of October, November, and December amounted to nearly $7,000,000, and those of January and February in California to about $2,500,000. The floods of March in the Chattahoochee, Alabama, and Tombigbee rivers also caused losses amounting to about $1,000,000. Including the damage from numerous minor floods, the total losses for the year probably amounted to between $16,000,000 and $17,000,000. These losses, though large, were unavoidable.

The forecasting of the floods by the Weather Bureau was characterized by the accuracy that has attended its work in former years, and the value of the property saved by the flood warnings probably equaled the total amount of the losses. The receipt during the year of thousands of testimonials and expressions of commendation is sufficient evidence of the value of the service to the public.

The daily river forecasts for the navigable rivers were also continued with the usual success and with much resulting benefit to the commerce of the watersheds affected.

The service has continued to expand along natural lines, and this expansion must go on in the future if the demands of commerce and agriculture are to be satisfied.

During the year new river districts were established as follows:

(1) Bismarck, N. Dak., with territory comprising that portion of the watershed of the Missouri River from Bismarck westward. This territory was formerly a portion of the Sioux City, Iowa, district.

(2) Wichita, Kans., with territory comprising that portion of the watershed of the Arkansas River from Wichita to the Kansas-Colo-

rado line. This territory was formerly a portion of the Fort Smith, Ark., district.

On July 1, 1909, the new district of Evansville, Ind., will be established, with territory comprising that portion of the watershed of the Ohio River from below Louisville, Ky., to the mouth of the Wabash River. This territory now forms a portion of the Cairo, Ill., district.

The equipment of the river stations has been carefully supervised, a special object being to secure river gauges of a substantial and permanent character. During the coming year it is proposed to install several additional automatic gauges of the Marvin pattern, if the necessary arrangements can be made.

The study of the flow of the Ohio River has been continued during the year, and the scheme of forecasting has been completed for that portion of the river between Pittsburg and Louisville. The work on the lower river will probably be completed during the coming year, and the scheme for the Mississippi River commenced.

No definite plans for new field work during the coming year have been determined. Its character and extent will depend largely upon the funds available. Increased service is much needed in portions of Oklahoma and northern Texas, along the eastern tributaries of the upper Mississippi River, and in a few other places. The further prosecution of the snow measurement service at the headwaters of the western streams, as well as the gradual completion of the irrigation projects by the Reclamation Service, will necessitate the establishment of an adequate number of gauging stations along the streams that derive their water supply from melting snows.

The question of river service over the Yukon River watershed is still in abeyance, owing to the continued absence of the necessary facilities for rapid transmission of reports.

INSTRUMENTS.

The routine work of the Instrument Division has increased greatly during recent years with the increased number of stations and the introduction of many new forms of apparatus, as has also the work of repairing and reconstructing instruments that become unserviceable through wear and exposure.

The only new station to be completely equipped with instruments during the year was Brawley, Cal., but partial equipment has been furnished nine special meteorological stations during that period.

The new and special work of the past year has been as follows:

(1) Installation of kiosks.

(2) Completion of work on installation of automatically recording river gauges at Cincinnati, Ohio, and Hartford, Conn., and the starting of similar work at Parkersburg, W. Va.

(3) The development of improved apparatus for the observation and study of evaporation and the equipment of a special station for this purpose at Salt Creek Bridge, Cal.

(4) The perfection of improved apparatus for measuring snowfall.

(5) The development of new apparatus for the measurement and registration of temperature and solar radiation.

(6) Seismological work.

The more important details of these different items of work may be thus described:

KIOSKS.—As mentioned in my last report, this device consists of an ornamental iron structure devised for installation on public thoroughfares or in parks for the purpose of exhibiting meteorological charts and bulletins and for maintaining certain meteorological instruments showing the temperature, humidity, rainfall, etc. During the past year structures of this character, with their appropriate equipment, have been assigned to twenty-one of the more important cities of the country, and all but five have been installed. The experience thus far has been that the kiosk meets a public need and is an object of general interest wherever located.

AUTOMATIC RIVER GAUGES.—The introduction of automatic river gauges at a few of the more important river stations has been of great value to local interests. They indicate in the local offices of the Weather Bureau the stage of the river, although the reading is not at present automatically recorded. These gauges have been especially valuable in flood seasons, enabling the observers to answer promptly all inquiries concerning the stages of the river. The importance of an automatic record of the stages is recognized, and experiments have been made during the past year to devise a suitable recorder, which it is proposed to test at Parkersburg, W. Va., upon the completion of the river gauge equipment at that place.

EVAPORATION OBSERVATIONS.—Mention was made in my last annual report of a special form of float for obtaining observations of evaporation by means of dial readings. The structural details of this float were improved during the year. A special form of magnifying burette tube was also devised. Two improved forms of apparatus for automatically recording evaporation have likewise been developed. One of these operates on the principle of the tipping bucket device employed in the measurement of rainfall, the water lost by evaporation from the pans being supplied at intervals by means of a tipping bucket that measures and records the amount. The other operates on the principle of a float, and is designed to record the wind movement in close proximity to the evaporation pan, as well as the amount of evaporation. All of these instruments will be used at the evaporation station at Salton Sea, and at other places where evaporation studies are to be carried on.

MEASUREMENT OF SNOWFALL.—The importance of securing precipitation records for the unpopulated regions of the West has led to a study of possible methods by which accurate precipitation measurements, especially snowfall, may be obtained. The measurement of the depth of snow gives but an imperfect idea of the amount of water represented by a given layer. A special form of collector and scale gauge has been devised to enable the water equivalent of the snow to be determined directly by dial readings. It is believed the introduction of this device will greatly increase the accuracy of observations of this character.

ELECTRICAL MEASUREMENT OF TEMPERATURE AND SOLAR RADIATION.—Over a year ago we introduced at a number of stations a form of electrical thermometer that would indicate in the Weather Bureau office at any moment the temperature of the air in the instrument shelter on the roof. The telethermoscope, as the instrument is called, measures the temperature by the variation in the electrical conductivity of a wire. Special pains have been taken to secure instruments of unquestioned accuracy. This has led to repeated tests, through which certain errors and discrepancies in temperature scales have been harmonized and a much more accurate grade of instruments obtained.

Solar radiation.—The apparatus for recording sunshine, and another apparatus for the absolute measurement of solar radiation, procured over a year ago, proved defective in mechanical construction. They were returned to the manufacturers and have only recently been received back. Preliminary examinations indicate that the original defects have been remedied, and it is now hoped to obtain satisfactory records through their use.

Seismological work.—The seismological work has consisted in the maintenance of records from the two instruments on hand. The absence of special provision for this work, and the lack of sufficient force to take up these studies actively, make it impossible to carry the work forward in a satisfactory manner. The United States Government is, in many respects, far behind other nations in giving seismological work its proper status, and the progress in other countries, especially throughout Europe, has been very marked during the past few years. Great improvements have been made in instrumental appliances, but much still remains to be done before these instruments can be placed in the hands of any except specially trained observers.

Seattle Exposition.—The Instrument Division indirectly supervised the preparation of the exhibit made by the Weather Bureau at the Alaska-Yukon-Pacific Exposition at Seattle, Wash., although this work was immediately in charge of the official assigned in charge of the exhibit, who looked after all the details and utilized, as far as practicable, the material remaining available from former expositions. It is believed that a very creditable and interesting exhibit of the Bureau has been realized.

CLIMATOLOGICAL DIVISION.

On July 1, 1908, the work of the Climatological Division was largely reorganized. The supervision of forecast distribution was transferred to the Distributing Division, while the preparation of matter for publication in the Monthly Weather Review and Annual Report of the Chief of the Bureau, and the preparation of general climatological data, together with the custody of the completed meteorological records of the Bureau, were carried over from the old Records Division, which was discontinued on June 30, 1908.

The collection and publication of climatological data in the form of monthly and annual section summaries for each of the forty-four section centers and the daily bulletins of the corn and wheat, cotton, and sugar and rice regions, have continued without material change.

The National Weather Bulletin was issued weekly during the crop-growing season, and monthly thereafter, as in the past, as also the weekly summary of snow and ice conditions, and the monthly snowfall bulletins of the Mountain and Plateau States during the winter season.

At the close of the crop season of 1908 the issue of weekly bulletins during the crop-growing season was permanently discontinued at all the section centers, except Iowa, Hawaii, and Porto Rico.

Inquiries on various subjects, dealing mainly with special climatic features of the various portions of the United States and its dependencies, showed marked increase, more than 2,500 such letters having been received during the year. Many of these included requests for certified data, for use in courts. All were promptly answered, and the information desired furnished as far as practicable.

No effort has been made to increase the number of reporting stations in eastern districts, in view of the large amount of data already available from those regions. In the districts west of the Rocky Mountains the opening up of new territory to settlement has necessitated the establishment of additional observation stations to meet the requirements of home seekers and others as to the prevailing climatic conditions.

Considerable progress has been made in compiling the climatological data collected during the past forty years in form convenient for ready reference. Small bulletins, 106 in number, covering the entire area of the United States, are being prepared, each of which will contain tables showing for a comparatively large number of points in the respective districts the details of precipitation by months and years, and a summary of temperatures, winds, frosts, and other important climatic features. The Water Resources Branch of the United States Geological Survey is furnishing valuable data regarding stream flow and water power where such measurements have been made, for incorporation in these bulletins.

During the year the organization of the climatological service in cooperation with the associated bureaus, namely, the Forest Service and Bureau of Plant Industry of the Department of Agriculture, the Reclamation Service and Water Resources Branch of the United States Geological Survey, and the Office of Indian Affairs, has been perfected, so that the operations are now mutually satisfactory and promise a wide field of usefulness. This cooperation is at present engaged upon two problems, the law of evaporation from large bodies of water and the recording of snowfall in the Rocky Mountain and Pacific coast ranges, from which the waters to supply the irrigation reservoirs are derived.

EVAPORATION.

Construction work at the Salton Sea, California, where the principal studies of evaporation will be conducted, has been completed and a camp established at the Salt Creek Trestle, with subordinate stations at Indio, Mecca, Brawley, and Mammoth—all in the Imperial and Coachella valleys of California.

Preliminary evaporation observations at Reno, Nev., and Indio and Mecca, Cal., enabled the campaign to be organized with the direct purpose of attacking certain unsolved features in the problem. It is hoped that the observations made during the next year or two will give the necessary data for a complete discussion of the subject.

In the summer of 1908 arrangements were made for evaporation observations at twelve of the projects of the United States Reclamation Service, as well as at four evaporation stations in charge of the water resources branch of the Geological Survey in the territory east of the Mississippi River. In this way simultaneous measurements of evaporation will be made in every type of climate, varying from the extremely dry climate of southern California, through the semiarid regions of the Rocky Mountain Plateau, to the humid climates of the Eastern and Southern States.

SNOWFALL IN THE MOUNTAIN REGIONS.

In the measurement of snowfall in the mountain regions, stations have been established in the Rocky Mountain and Pacific States, where comparative observations are being made with several kinds of apparatus, namely, a large snow bin, which is a 5-foot cubical box standing on stilts 5 feet above the ground; a standpipe, which is a galvanized-iron pipe 10 feet high and 10 inches in diameter, provided with a movable section at the bottom; a large platform on the ground, about 10 feet square; small vertical scales fixed against posts, tree trunks, etc., in the open; and, finally, the ordinary Weather Bureau snow gauge. It is proposed to vary the attachments on the snow bin by putting louvers on the inside and certain forms of screens or catches near the top of the bin, which will tend to extract from the horizontal sheet of air blowing at a high velocity an amount of snow equivalent to that which would fall vertically into a bin in a calm. This is a mechanical problem, but it must be worked out by actual experiment in addition to what suggestions can be derived from theoretical construction.

The results of experiments thus far indicate that the snow bin is capable of development, but that the long standpipe, the large platform, and the small snow gauge have such serious defects that they are not very promising. The vertical snow scales will be distributed widely in the remote regions of the mountains, where they can be visited on occasional trips, especially during the latter half of the winter.

There are, of course, large areas in these mountains where observers can not be secured, but the districts will be covered as far as possible. About 300 snowfall stations were all that could be established this season, as the campaign did not properly open until some snows had fallen in the early winter, after which it became difficult to make the necessary journeys into the mountain districts.

The associated bureaus are rendering efficient and valuable service in securing observers, installing stations, and making special observations. The Forest Service has submitted numerous interesting suggestions regarding a device for storing the snowfall of a whole season, which it is very desirable to develop, but until the problem of separating the drifting snow from the falling snow is much nearer solution than at present it will not be practicable to put such mechanism into successful operation.

NEW METHODS OF PUBLICATION.

With a view to consolidating and unifying the climatological data of the Weather Bureau for their more convenient use by agriculturists, transportation companies, and engineers engaged in the conservation of water resources, and for a study of certain forest problems, it has been thought proper to remodel the system of publications in the following manner, beginning with July, 1909:

The United States has been divided into 12 large districts, each one covering a natural drainage area as determined by the topographical divides, and these will be made the units of publication. The section directors will contribute their quota to the several divisions, and division editors have been charged with preparing data for publication. Each district will prepare a general summary of the climatic conditions and a series of tables, giving the general climatology for the month, the daily precipitation at a large number of stations, and the maximum and minimum temperatures at a number of selected stations. Two charts, one showing the distribution of the monthly precipitation and the other the temperature changes, will accompany the summary and tables. The division editor will forward the copy to the central office in Washington, where it will be finally edited and printed and incorporated in the Monthly Weather Review. This Review will contain the usual data for the River and Flood Service and the Forecast and Storm Warning Service, and such strictly climatological articles as may be assigned to it. It may be that the five bureaus associated with the Weather Bureau will make suitable monthly contributions, showing the relation of the climatological and meteorological data to their practical uses from the point of view of the engineer, the forester, and the agriculturist.

The prospective development of the subject of the conservation of the natural resources of the United States, whether of soils, water power, navigation, or forests, would seem to call for some general journal representing the mutual interests that exist between these branches of the Federal Government. Since temperature and precipitation form the two essential features of climate and since the records of the Weather Bureau form an invaluable basis upon which to build scientific and practical studies, it would seem natural that the Monthly Weather Review should attempt to cover this field of usefulness. The more strictly scientific papers in the interests of meteorology will be printed in the quarterly bulletin of the Mount Weather Observatory, or in separate form.

The editing of the Monthly Weather Review has been transferred to the Climatological Division and it will be amalgamated with the monthly section climatological reports. The Annual Report of the Chief of Bureau will receive some slight modifications, so as to avoid duplicate publication of climatological data.

MARINE DIVISION.

This division is charged with the collection and compilation of ocean meteorological data, the supervision of the wireless telegraph weather service, and the work of the vessel-reporting service.

Twenty-three Weather Bureau stations act as marine centers in the furtherance of this work. All but two have been supplied with a standard marine barometer, model shelter, and thermometers for exhibition and for use in making comparisons with ships' instruments. Upon their arrival at any of these centers, or at any foreign port, vessels are requested to furnish comparative readings of their barometers in order that the proper correction may be furnished.

Marine forms, cloud and ocean charts, pamphlets of instructions, etc., are kept on hand at the marine centers and the American consulates for filling requests from cooperating observers. Under an arrangement with the State Department, 95 American consulates receive marine forms and forward them to Washington with their official mail.

During the last fiscal year 2,201 vessels of all nationalities cooperated with the Bureau, reporting pressure, temperature, wind, and other meteorological data. The data thus obtained are used in the preparation of the monthly pilot charts issued by the Hydrographic Office and the meteorological charts issued by the Weather Bureau.

To increase interest in this work, the Bureau has published a calendar for the use of mariners, which it furnishes to the captains of cooperating vessels, in addition to the usual supply of ocean and cloud charts.

DAILY SYNOPTIC CHARTS.

The data placed on these charts are used in determining the storm tracks and in the preparation of the statement of average conditions of wind and weather that appear monthly on the pilot and meteorological charts. Each monthly chart for the North Atlantic Ocean is based on an average of 3,150 reports, and that for the Pacific on 1,020 reports.

PILOT CHARTS OF THE OCEANS.

The revision of the meteorological data for the pilot chart of the North Atlantic Ocean, for the Hydrographic Office, has been completed. The chart contains pressure normals covering a period of eighteen years, and temperature normals and wind rose data for twenty-five years, all based on a large number of observations for each 5-degree square of latitude and longitude. Averages of the direction and force of the wind and the percentage of gales and calms cover a period of twenty-five years.

The revision of the meteorological data for the North Pacific Ocean Pilot Chart, for the Hydrographic Office, has been completed, giving new normals of pressure and temperature, wind rose data, averages of the direction and force of the wind, and the percentage of gales and calms for periods of twenty to twenty-five years.

Beginning with the winter season, June, July, and August, a chart for the South Atlantic Ocean, giving the prevailing winds, calms, trade-wind limits, and percentage of gales, together with an inset chart of normal pressure and temperature, was furnished to the Hydrographic Office for publication on the Pilot Chart. The data are furnished forty days in advance of the date on which the chart is issued. This is the first publication of the Pilot Chart of the South Atlantic since the last issue of Lieutenant Maury's chart in 1859.

At the request of the Hydrographic Office, the compilation of the meteorological data for publication on the Pilot Chart for the South Pacific Ocean was taken up, and has been so far advanced that the data will be published for the summer season, December, January, and February. This will mark the resumption of the South Pacific Pilot Chart, not published since the last issue of Lieutenant Maury's chart in 1859.

Some of the data for the Indian Ocean are entered on the charts for the South Atlantic and some on those for the South Pacific. All meteorological reports received from vessels sailing this ocean are sent every six months to the meteorological office, Simla, India, where they are copied and then returned to this office.

FOG.

The revision of the entire fog data for the North Atlantic chart has recently been completed. The necessity for this revision was emphasized by Mr. James White, geographer, department of the interior, Ottawa, Canada, in his request for data relating to the northern route to Europe and the central fog banks of Newfoundland. Mr. White has been furnished with a complete set of fog charts, for which acknowledgment has been made.

METEOROLOGICAL CHARTS OF THE OCEANS.

To meet the demands of vessel captains and others interested meteorological charts of the North Atlantic, North Pacific, and South Atlantic oceans have been published, showing pressure and temperature normals, trade-wind limits, storm tracks, percentage of gales and fogs, prevailing winds and calms, and average conditions of wind and weather over each ocean. The storm-warning signals used by all the countries of the world, symbols showing the wireless telegraph and life-saving stations, and much other information of value to seafaring people also appear on the charts. The first issue of 3,000 North Atlantic, 1,500 North Pacific, and 1,000 South Atlantic charts fell short of the demand from marine stations, American consuls, vessel captains, and others, so the next issue was increased to 5,000 North Atlantic, 2,500 North Pacific, and 2,000 South Atlantic charts.

WIRELESS TELEGRAPH SERVICE.

Reports of marine observations by wireless telegraph service have been discontinued on the Atlantic. The work has been taken up by the Weather Bureau officials at San Francisco, Cal., and Portland, Oreg., but trouble has been experienced in utilizing these observations on the Pacific coast, on account of the short distance that messages can be sent.

The Weather Bureau official in charge at San Francisco has made arrangements with the Toyo Kisen Kaisha Company, and also with the United States army transports plying between San Francisco and the Philippines, for regular messages. The messages are handled by the United Wireless Company and the naval wireless land stations and delivered without cost. Wireless reports are also received from the steamers of the Matson Navigation Company. These reports are utilized at San Francisco in connection with the forecast work. The Weather Bureau official at Portland, Oreg., has arranged with the manager of the Marine Transportation Company and with vessels of other companies plying between Portland, Seattle, and Alaska, to have wireless messages sent to his station. These reports are received at Cordova or Katalla, Alaska, and transmitted by cable by the wireless telegraph companies free of charge, thus enabling the Portland official to get the reports when the vessels are farther up the coast. During the last fiscal year 177 reports were made, but only 29 were received in time to be utilized in the forecast work at Portland.

VESSEL-REPORTING SERVICE.

In addition to their meteorological work, the stations at Block Island, Cape Henry, Jupiter, Sand Key, Southeast Farallon, and North Head are required to report all passing vessels, wrecks, marine disasters, and casualties, and to transmit communications between masters, owners, underwriters, and others interested. The stations at Cape Henry, Jupiter, and Sand Key are equipped for signaling by international code, and are prepared to transmit messages by telegraph. Sand Key can also receive messages by flashlight signal—Morse code. Each vessel-reporting station has a list of names of the vessels that belong to the various companies, and immediately upon sighting a vessel a message is sent to the owner and the Maritime Exchange.

At Cape Henry the office is kept open day and night. That station reported 18,093 vessels, received and delivered orders from 853 vessels, reported 17 wrecks, sent regular reports to 89 firms and 5 maritime exchanges, and other reports to 1,424 private individuals during the year. The pilot boats and other vessels off Cape Henry are notified of the noon hour each day by dropping the time flag, similar to the dropping of a regular time ball, the time being sent by the Western Union to the office. This attention is much appreciated by tugboats and other vessels off the capes.

During the year Jupiter sent 586 messages, North Head 1,890, Point Reyes 902, Southeast Farallon 193, Sand Key 1,594, Tatoosh Island 1,664, and Port Crescent 176; in all, including the Cape Henry service, a total of 25,220 messages. In connection with this enormous service only one complaint was received, and upon investigation the official charged with blame was entirely exonerated.

LIBRARY.

Through the addition of 1,061 books and pamphlets to the library during the fiscal year the total number has reached about 29,000. Important accessions include an extra file of the Meteorologische Zeitschrift, 1884–1908, and a file of the Bulletin of the Imperial Academy of Sciences of St. Petersburg, volumes 6–25, inclusive.

A large number of purchases were made for the purpose of duplicating the more important works in the library in order to have copies available for lending to stations.

A " Brief List of Meteorological Text-books and Reference Books " was prepared for publication by the librarian and issued toward the end of the year. This compilation was designed to guide the librarians of large general, scientific, and university libraries in the United States in selecting meteorological literature for their collections, and also to provide a ready means of complying with the many requests received by the Bureau from teachers, students, and others for the titles of books dealing with meteorology and its several branches.

The library has recently been made a depository for the printed catalogue cards of the Library of Congress for all publications on meteorology and climatology. Arrangements have also been made whereby surplus publications on these subjects received by the Library of Congress are turned over to the library of this Bureau.

EXAMINATIONS FOR PROMOTION.

The total number of examination papers received during the year was 223, as compared with 236 during the preceding year. Following is the record in detail:

Number of examination papers received.

Subject.	1908.		1909.		Total.	Passed.	Failed.
	August.	November.	February.	May.			
English grammar	7	5	14	14	40	23	17
Arithmetic	3	7	14	12	36	29	7
Elementary meteorology	6	3	9	9	27	24	3
Algebra	2	1	8	11	22	22	0
Physics	4	4	3	8	19	15	4
Trigonometry	3	3	4	5	15	15	0
Essay writing	5	3	10	9	27	16	11
Astronomy	2	4	2	3	11	11	0
Plant physiology	3	4	3	6	16	16	0
Advanced meteorology	2	0	4	4	10	10	0
Total	37	34	71	81	223	181	42

The examination in English grammar has been put upon a more satisfactory basis by the adoption of a specified text-book as authoritative in rating papers. This action was taken in view of the diversity of opinion among grammarians on many points involved in this examination.

STUDENTS FROM FOREIGN COUNTRIES.

In November, 1908, the governor of the State of Jalisco, Mexico, sent two young men to Washington to study general meteorology and Weather Bureau methods, preparatory to the establishment in his State of a climatological and forecast district cooperating with the general meteorological service of Mexico, and patterned after the climatological and forecast districts in the United States.

At about the same time the Mexican Government sent two young men from its Central Meteorological Observatory to Washington to study modern meteorology and its practical applications as exemplified in the work of the Weather Bureau, especially as applied to weather forecasting.

The immediate supervision of the meteorological education of these young men was assigned to one of the professors, who arranged a brief course in theoretical meteorology, consisting in part of lectures by himself and other members of the scientific staff, and in part of written work based on a course of reading suggested by him. In addition, the students were given access to the apparatus in the observatory and in the Instrument Division, to the manuscript weather maps in the Forecast Division, and to the meteorological literature and data in the library. Individual students also specialized on lines of work in which they were particularly interested.

Arrangements were also made for visits to the central offices of climatological and forecast districts and to the research observatory at Mount Weather, Va.

The students from Jalisco returned to Mexico after about six months of study. They have already entered upon the work of organizing a meteorological service for their State, and the governor of Jalisco has expressed himself as well pleased with the results of their visit to this country.

One of the students from the Mexican Central Observatory is now at the Mount Weather Observatory, and the other at the station at Burlington, Vt.

SCHOOL OF INSTRUCTION.

The work of instructing assistant observers at the central office was begun the 1st of November with a class of 10 young men, all of whom had passed the required civil-service examination and received probationary appointments.

The course of instruction includes the study of Station Regulations and the Weather Cipher Code; practicing typewriting and telegraphy; taking, recording, and telegraphing observations; preparation of meteorological forms; charting weather conditions as reported twice daily from all stations in the United States and Canada; care of meteorological instruments; and the various other duties performed at stations.

Of this class, one was transferred to another branch of the government service and the others were all qualified for station assignment by the 1st of April.

A second class of 9 probationary appointees was formed in March. Four are now ready for station assignment and the others will be ready within a few weeks.

Three Mexican students took most of the course of instruction with the first class.

At such times as it could be done without interfering with their regular work, 9 compositors of the Weather Bureau and 1 probationary appointee were instructed in translating cipher reports, casting chalk-plate weather maps, and the necessary knowledge of presswork in connection therewith. These men are now all thoroughly competent to do station printing.

DISTRIBUTING DIVISION.

The Distributing Division came into existence on July 1, 1908. It is charged with the general supervision of weather forecast and special-warning distribution, and has administrative control of the storm-warning display stations of the Bureau. With a few exceptions, it sees to the distribution of all weather maps, forecast cards, and meteorological forms. It has the custody and distribution of Weather Bureau publications and handles all newspaper clippings. The examination and correction of all meteorological forms, except those of the Marine Division, and the examination of station weather maps and forecast cards, also form a part of the duties of this division.

DISTRIBUTION OF WEATHER FORECASTS AND SPECIAL WARNINGS.

The daily weather forecasts are sent by telegraph or telephone at government expense to 2,370 places for redistribution by various means; this number is slightly greater than at the close of the previous year. The distribution by telephone is now the most prompt and effective means employed. In a few States there has been a reduction in the number of telephone companies cooperating gratuitously in this work and in others an increase.

The following table gives in detail the number of forecasts and special warnings distributed in the various States and Territories of the United States.

Distribution of daily forecasts and special warnings.

State.	At government expense.			Without expense to United States by—				
	Forecast and special warnings.	Special warnings only.	Emergency warnings.	Mail.	Rural delivery.	Telephone.	Railroad train service.	Railroad telegraph.
Alabama	33	3	139	1,106	416	4,715	0	96
Arizona	8	1	0	203	0	3,294	0	0
Arkansas	38	8	102	652	517	24,947	0	13
California	121	36	0	1,452	4,059	65,592	0	0
Colorado	18	61	39	1,410	1,682	21,400	0	0
Connecticut	16	0	49	1,389	50	61,269	141	0
Delaware	9	0	0	98	296	4,865	0	29
District of Columbia	0	0	0	1,488	0	10,000	0	2
Florida	36	113	32	1,056	263	7,406	0	58
Georgia	41	31	241	2,071	1,307	23,772	0	214
Idaho	19	0	0	710	360	14,542	0	0
Illinois	111	0	468	3,065	2,809	319,662	0	17
Indiana	115	1	208	2,201	1,620	148,611	0	66
Iowa	62	6	400	2,276	3,819	255,185	25	0
Kansas	100	1	186	1,337	2,440	126,328	0	15
Kentucky	43	32	96	1,693	788	67,289	0	1
Louisiana	77	24	61	632	328	17,197	0	16
Maine	16	1	40	1,076	877	12,764	0	0
Maryland	22	4	42	1,855	980	8,459	0	82
Massachusetts	23	12	63	3,173	210	8,950	78	0
Michigan	86	1	379	4,689	374	121,650	279	371
Minnesota	84	4	196	2,293	4,146	141,000	0	18
Mississippi	44	7	118	1,168	958	22,456	0	6
Missouri	45	0	240	3,384	2,121	244,705	0	26
Montana	11	21	18	480	0	10,424	0	0
Nebraska	84	1	221	1,103	408	113,846	0	0
Nevada	6	0	0	68	0	907	0	0
New Hampshire	20	0	34	902	1,429	2,352	15	0
New Jersey	30	18	45	1,198	0	21,762	0	187
New Mexico	11	1	0	74	0	4,451	0	17
New York	140	45	365	7,063	2,194	321,084	196	158
North Carolina	87	12	189	782	2,160	16,978	0	0
North Dakota	24	0	99	213	1,889	14,470	0	0
Ohio	100	192	312	6,568	1,384	458,644	24	26
Oklahoma	33	1	17	665	1,105	7,701	0	192
Oregon	10	0	0	500	183	11,456	0	0
Pennsylvania	86	11	367	3,918	1,718	154,878	1	499
Rhode Island	5	0	12	490	0	908	11	0
South Carolina	33	9	109	878	612	4,730	0	40
South Dakota	64	11	77	795	250	30,576	0	0
Tennessee	55	3	291	1,113	1,050	22,946	0	3
Texas	147	53	240	975	2,149	54,443	0	59
Utah	8	35	0	111	826	31,806	0	0
Vermont	16	0	46	489	701	13,857	12	8
Virginia	61	4	96	1,388	1,618	22,931	101	70
Washington	24	1	0	760	1,091	2,786	0	0
West Virginia	30	7	55	908	7	28,749	0	16
Wisconsin	112	7	298	2,520	2,208	51,391	0	0
Wyoming	6	4	8	125	0	8,751	0	0
Total	2,370	782	5,998	77,563	53,402	3,143,985	883	2,305

STORM-WARNING DISPLAY STATIONS.

Storm-warning display stations on the Atlantic, Pacific, and Gulf coasts and on the Great Lakes have been maintained at 318 places, so distributed as to serve best the needs of the marine interests. The display of storm warnings has been discontinued at 18 stations, while this service has been established at 10 stations during the year.

The following statement gives the number of stations, arranged under district centers, receiving storm warnings:

Centers.	Paid stations.	Cooperative stations.	Weather Bureau stations.	Naval wireless stations.
Alpena, Mich	6	0	1	0
Atlantic City, N. J	1	6	2	0
Baltimore, Md	3	1	0	0
Block Island, R. I	1	0	1	0
Boston, Mass	23	8	3	4
Buffalo, N. Y	11	2	1	0
Charleston, S. C	5	1	1	0
Chicago, Ill	25	1	0	0
Cleveland, Ohio	10	0	1	0
Corpus Christi, Tex	2	0	1	0
Detroit, Mich	0	1	1	0
Duluth, Minn	5	0	1	0
Eastport, Me	0	0	1	0
Erie, Pa	1	0	0	0
Escanaba, Mich	2	0	1	0
Eureka, Cal.[a]	0	0	1	0
Galveston, Tex	4	3	1	0
Grand Haven, Mich.[a]	0	0	1	0
Green Bay, Wis.[a]	0	0	1	0
Houghton, Mich	2	2	1	0
Jacksonville, Fla	6	4	1	0
Jupiter, Fla	1	0	1	0
Key West, Fla	0	0	2	0
Los Angeles, Cal	1	3	0	0
Marquette, Mich	1	0	1	0
Milwaukee, Wis	9	0	1	0
Mobile, Ala	4	0	1	0
Nantucket, Mass.[a]	0	0	1	0
New Haven, Conn	2	0	1	0
New Orleans, La	4	2	1	0
New York, N. Y	5	7	1	3
Norfolk, Va	6	2	4	2
Pensacola, Fla	4	0	1	0
Philadelphia, Pa	4	0	1	0
Port Huron, Mich	4	1	1	0
Portland, Me	3	4	1	0
Portland, Oreg	7	4	7	0
Providence, R. I	1	0	0	0
San Diego, Cal	0	2	1	0
Sandusky, Ohio[a]	0	0	1	0
San Francisco, Cal	2	6	4	5
San Juan, P. R	0	0	0	2
Sault Ste. Marie, Mich	5	0	1	0
Savannah, Ga	4	2	1	0
Tampa, Fla	3	2	1	0
Toledo, Ohio[a]	0	0	1	0
Wilmington, N. C	3	2	1	0
Total	180	66	57	16

[a] Not centers.

The following table shows the number of publications received and distributed at the central office:

Title.	Received.	Distributed.
Annual Report of the Chief of the Weather Bureau	1,000	865
Annual Summary of the Monthly Weather Review	9,600	9,250
Bulletin of the Mount Weather Observatory	3,300	2,531
Monthly Weather Review	47,800	46,675
National Weather Bulletin	71,865	69,765
Snow and Ice Bulletin	22,225	21,375
Washington Weather Map	474,055	449,530
Special bulletins, etc	7,500	5,338
Miscellaneous publications	....	3,928
Total	637,345	609,257

The nearly 4,000 miscellaneous publications distributed during the year represent the action taken upon as many or more letters of request received from various sources.

STATION PUBLICATIONS.

Daily weather maps are issued at 112 stations. At 33 stations the maps are printed, and at 79 are issued by duplicating process. The total number of maps issued during the year at all Weather Bureau map stations was about 10,500,000. The Boston station leads in the issue of weather maps, considerably more than a half million copies having been printed and distributed during the year, while Chicago and New York each printed and distributed more than 400,000.

Daily weather bulletins (Forms No. 1038—Met'l) were issued at 12 stations, the total annual output being about 125,000 copies. These bulletins are prepared by duplicating process.

TELEGRAPH DIVISION.

The Norfolk-Hatteras section of the Weather Bureau telegraph and telephone lines was maintained in good condition during the entire year, but frequent short interruptions occurred, due to leaks in the submarine cable between Nags Head and Manteo, N. C. In the vicinity of the Duns at Nags Head, lightning is usually very severe and has caused frequent trouble by burning out the lightning arresters, shattering poles, and on two or three occasions escaping into and rupturing the cables at Shallow Bag Bay and Oregon Inlet, North Carolina. A cable from the southern end of Roanoke Island to Chicamacomico, N. C., 20 miles in length, is urgently recommended. It would do away with the trouble that frequently occurs at Oregon Inlet, New Inlet, on the low flat beaches on Bodys Island, and in the vicinity of Nags Head. The new cable and 6 or 8 miles of land line would cost about $25,000.

The Beaver Island section from Charlevoix to St. James, Mich., was interrupted in St. James Harbor, August 27, 1908, by the screw steamer *Fanny Hart*, of the Green Bay Transportation Company, accidentally fouling and breaking the submarine cable, which was repaired September 9, 1908, at a cost of $37.

The Southeast Farallon-Point Reyes-San Francisco section has been out of order during the entire year, owing to trouble in the submarine cable between Drakes Bay and the Southeast Farallon Island. The cable was first tested on August 7, 1908, and was underrun and tested from ten different places, several miles apart, between the above-mentioned points on March 14, 15, and 16, 1909. It was found defective at all of the ten places, due probably to earthquake ruptures and burrowing of teredoes. Deep water and sandy bottom can be secured all the way for a new cable from 2 or 3 miles north of Point Reyes, excepting the landing in the bight at Southeast Farallon Island, where for one-fourth of a mile rocky bottom will be found. It will cost about $24,000 to put down a new cable between Southeast Farallon Island and Point Reyes Light. The land line from Point Reyes Light-House to Point Reyes, or Olema railroad station, is about 22 miles in length, and is in poor condition. The official in charge at San Francisco has been directed to report as to the cost of putting the line in first-class order.

The remaining sections of the Weather Bureau telegraph and telephone lines conducted business with little or no interruption, and at small expense for repairs.

PUBLICATIONS DIVISION.

The printing of the Washington Daily Weather Maps, Monthly Weather Reviews, Weekly and Monthly National Weather Bulletins, Snow and Ice Bulletins, and the Bulletin of the Mount Weather Observatory has continued during the year. The distribution of the various publications was transferred to the Distributing Division.

Forms, maps, and forecast cards have been supplied to all stations.

The publication of meteorological charts of the oceans was begun, and the Weekly Weather Bulletin, which had been discontinued at the close of the season of 1908, was resumed on May 18, 1909.

The mechanical equipment was enlarged by the addition of a Harris press and a folding machine.

For use in disseminating forecasts there were printed:

Station maps	10, 025, 000
Forecast cards	21, 978, 316
Rural delivery slips	4, 547, 250
Total	36, 550, 566

The following statement shows the amount of work done:

	No. of copies.
Monthly Weather Review, May, 1908, to March, 1909, inclusive, and the Annual Summary, 1908	57, 175
Bulletin of the Mount Weather Observatory, Nos. 3 and 4, 1908, and No. 1, 1909	3, 300
Maps DD and E for station use	7, 803, 900
Forecast cards for stations	21, 978, 316
Rural delivery slips	4, 547, 250
Blank forms for office and station use	4, 139, 640
Miscellaneous work	960, 071
Daily River Stages, Part VIII (completed during the year)	500

The following shows the work of the lithograph presses:

Daily weather maps	472, 695
Charts for the Monthly Weather Review	424, 960
Ocean charts	15, 080
Snow and ice bulletins	22, 225
National weather bulletins	67, 075
Manifold maps	19, 460
Maps A for station use	50, 335
Miscellaneous charts and forms	91, 040
Charts for the Forest Service	79, 990

In addition to the above, 2,225,000 Maps DD and E were printed at the office of the Public Printer.

DIVISION OF SUPPLIES.

To the usual routine work of the division there was added the issuing of our own bills of lading, except in a few special cases, for all freight shipments of the Bureau, both from Washington and from stations. Prior to the adoption of this method, all bills of lading were issued by the Quartermaster's Department. The change has resulted in expediting shipments two or more days in every instance.

Economy in the purchase of the necessary supplies, without impairment of standard quality, has been kept constantly in view. Material reductions in the prices of duplicating ink and stencil paper for the coming year have been among the results.

Greater security of our stock of supplies from interference by unauthorized persons was effected by closing the aisles in the main storerooms with strong wire mesh work fitted with collapsible iron doors or mesh-work sliding doors, that are kept locked during the absence of the storekeeper or his assistant.

OBSERVATORY BUILDINGS.

The appropriation bill for the fiscal year 1909 authorized the completion of the cottage and office building and the physical laboratory building at Mount Weather, Va., the erection of a main observatory building to replace the building that was destroyed by fire on October 23, 1907, and the construction of a central heating and power station. The cottage and office building was completed in the latter part of September, 1908, and the physical laboratory building on March 1, 1909. The central heating plant was finished about December 15, 1908; a boiler, engine, and dynamo have been installed therein, and it is now in operation and is supplying all the heat and power required at Mount Weather.

The main observatory building is in course of erection and rapid progress is being made toward its completion. It is built mainly of brick, tile, and concrete, with a view of making it fireproof. Under the terms of the contract this building will be completed about March 1, 1910, but at the present rate of progress it is likely that it will be ready for occupancy at an earlier date.

The appropriation bill for the fiscal year 1909 also provided for the erection of seven observatory buildings, to be located outside of Washington, D. C., at a total cost of $105,000. These buildings are now under way at Abilene, Tex., Canton, N. Y., Dodge City, Kans., East Lansing, Mich., Northfield, Vt., Richmond, Va., and St. Joseph, Mo., and it is expected that all of them will be completed and occupied not later than February 1, 1910.

The following table shows where the buildings owned by the Weather Bureau are located, and gives the cost of the buildings and grounds:

Buildings owned by the Weather Bureau.

Location.	Cost of ground.	Cost of buildings.	Total cost.
Abilene, Tex	$2,000.00	[a] $12,879.81	$14,879.81
Amarillo, Tex	1,255.00	6,503.00	7,758.00
Anniston, Ala	1,799.75	12,920.69	14,720.44
Atlantic City, N. J	(b)	5,991.00	5,991.00
Bentonville, Ark	500.00	5,119.90	5,619.90
Birmingham, Ala	[c] 61.50	15,630.36	15,691.86
Bismarck, N. Dak	(b)	10,085.99	10,085.99
Block Island, R. I	1,034.50	7,668.25	8,702.75
Burlington, Vt	[c] 20.00	10,043.50	10,063.50
Canton, N. Y	[c] 1.35	[a] 13,955.82	13,957.17
Cape Henry, Va	(b)	9,222.45	9,222.45
Charles City, Iowa	3,036.75	9,338.47	12,375.22
Columbia, S. C	3,799.00	9,165.00	12,964.00
Devils Lake, N. Dak	2,209.05	7,431.50	9,640.55
Dodge City, Kans	2,050.00	[a] 10,811.89	12,861.89
Duluth, Minn	2,041.70	7,430.68	9,472.38
East Lansing, Mich	[c] 11.35	[a] 12,778.14	12,789.49
Hatteras, N. C	[b] [d] 217.00	4,889.75	5,106.75
Havre, Mont	1,795.00	5,087.08	6,882.08

[a] Not completed.

[b] Government reservation.

[c] Donated; figures represent cost of title transfer.

[d] Additional ground purchased.

Buildings owned by the Weather Bureau—Continued.

Location.	Cost of ground.	Cost of buildings.	Total cost.
Iola, Kans	$2,241.25	$9,730.94	$11,972.19
Jupiter, Fla	(a)	6,346.90	6,346.90
Key West, Fla	2,020.00	7,994.75	10,014.75
Kittyhawk, N. C	(a)	1,616.00	1,616.00
La Crosse, Wis	3,523.50	12,276.24	15,799.74
Modena, Utah	(a)	4,346.00	4,346.00
Mount Weather, Va.:			
Administration building	1,863.15	[b]48,035.26	49,898.41
Machine shop and balloon shed	650.00	8,167.00	8,817.00
Central heating and power plant	(a)	11,964.74	11,964.74
Absolute building	(a)	7,000.00	7,000.00
Variation building	(a)	8,904.55	8,904.55
Stable	(a)	1,900.00	1,900.00
Barn	(a)	900.00	900.00
Cottage for workmen	(a)	1,300.00	1,300.00
Physical laboratory	(a)	37,521.51	37,521.51
Cottage and office	(a)	11,246.34	11,246.34
Nantucket, Mass	(c)	4,728.53	4,728.53
Narragansett Pier, R. I	4,151.75	8,036.50	12,188.25
Northfield, Vt	[d]101.00	[e]12,705.64	12,806.64
North Head, Wash	(a)	3,820.13	3,820.13
North Platte, Nebr	(c)	3,818.50	3,818.50
Oklahoma, Okla	[d]38.90	10,520.25	10,559.15
Peoria, Ill	[d]54.00	7,875.50	7,929.50
Point Reyes Light, Cal	(a)	2,875.00	2,875.00
Port Crescent, Wash	102.00	730.94	832.94
Richmond, Va	[d]8.75	[e]15,237.05	15,245.80
St. Joseph, Mo	5,040.95	[e]16,792.40	21,833.35
Sand Key, Fla	(a)	5,593.00	5,593.00
Saulte Ste. Marie, Mich	(a)	2,994.12	2,994.12
Sheridan, Wyo	2,021.75	12,089.30	14,111.05
Southeast Farallon, Cal	(a)	5,211.22	5,211.22
Springfield, Ill	(a)	10,236.50	10,236.50
Tatoosh Island, Wash	(a)	5,000.00	5,000.00
Washington, D. C	(c)	174,950.79	174,950.79
Yellowstone Park, Wyo	(a)	11,156.00	11,156.00
Yuma, Ariz	(a)	1,500.00	1,500.00
Total	43,648.95	672,074.88	715,723.83

[a] Government reservation.
[b] Estimated; not completed.
[c] Building and ground purchased as a whole.
[d] Donated; figures represent cost of title transfer.
[e] Not completed.

Buildings rented by the Weather Bureau for living and observatory purposes.

Station.	Annual rent.	Other items included.
Alpena, Mich	$650	Heat, light, water.
Brawley, Cal	300	Water.
Clallam Bay, Wash	120	Do.
Del Rio, Tex	444	Heat, light, water.
Durango, Colo	318	Water.
Flagstaff, Ariz	420	
Helena, Mont	504	Steam heating plant, water.
Honolulu, Hawaii	1,020	Six rooms; heat, cleaner, light, janitor and porter service, electric current for fan, storage.
Independence, Cal	456	Water, and the trimming and care of all trees on the premises.
Kalispell, Mont	360	
Lewiston, Idaho	540	
Manteo, N. C	144	
Moorhead, Minn	600	Heat, light, water.
Mount Tamalpais, Cal	420	Heat, light, water, and free transportation of Government employees and supplies.
Pysht, Wash	144	Water.
Roseburg, Oreg	550	Heat, light, water.
Roswell, N. Mex	720	Heat, cleaner, light.
San Juan, P. R	600	Ten rooms.
Thomasville, Ga	420	
Tonopah, Nev	840	
Twin, Wash	108	Water.
Williston, N. Dak	510	Heat, cleaner, light, water.
Winnemucca, Nev	480	Heat, light, water.
Total	10,668	

PERSONNEL OF THE BUREAU.

The total numerical strength of the Bureau at the close of the fiscal year under consideration was 6,610, against 7,508 at the end of the year preceding. These figures include all classes of employees. The large reduction indicated is due almost entirely to a decrease of more than 1,000 in the number of weather correspondents, whose cooperative services were dispensed with following the discontinuance of the section weekly weather bulletins. In nearly every other branch of work the number of employees was slightly increased.

An analysis of the statement that follows and a comparison of its figures with those for the previous year will show, it is believed, a satisfactory condition as regards the general character of the working force and the discipline of the service.

In the classified service of the Bureau there was a marked increase in the number of promotions over those for the year before, the excess amounting to 145. All promotions but 2 were made to the next higher grade. One of the exceptions was in filling the office of librarian, in which instance the only clerk having the necessary qualifications for the place was advanced from the $1,400 to the $2,000 grade, the latter salary being provided by law for the position. In the other case, the clerk was advanced two grades because of his assignment to an isolated station in the Southwest, where it was impossible for his family to accompany him, thus requiring him to maintain two establishments. There was 1 less permanent appointment, 7 fewer temporary appointments, and a decrease of 24 in the number of resignations. The increase of 7 in the number of removals for cause testifies to the maintenance of a high standard of official and moral conduct. Out of 101 probationary appointments during the year only 1 was dropped for unsatisfactory services at the end of the six months' trial period. A record of 42 voluntary resignations during the year, against 68 for the year preceding, signifies a state of general satisfaction on the part of the employees, this indication being further strengthened by the fact that the number of reinstatements was as great as in the preceding year of a larger number of resignations.

For the unclassified service the total of permanent and temporary appointments was slightly decreased, as compared with the previous year. This action has been in conformity with the policy of the Bureau to make up its force as far as possible from the classified lists.

In the distribution of the commissioned employees of the Bureau there has been an increase of 34 in the station force over the number for the preceding year. This has been brought about by the assignment of an additional man at a number of the larger cities where the press of work has become heavy, and by the taking up of new lines of investigation in the field, such as the evaporation experiments that are now being conducted in southern California. At a few stations it has been found possible to reduce the force by one employee, in order to help meet requirements at other places.

At the central office the number of commissioned employees is 14 greater than at the close of the previous year. This number, however, includes 9 student observers, who will be assigned to station duties at the end of their term of instruction. Changes in the duties of some of the divisions at the central office have altered slightly the number of employees, but in most of the divisions the force has remained much the same, in spite of the gradual increase in the amount of work performed, due to the continued expansion of the Bureau in its various lines of service.

For the Bureau as a whole there was an increase of a fraction of a day in the amount of absence due to sickness, as well as to annual leave, over the record for the year before, the average absence for each employee for both causes being slightly less than fifteen days. There were only 3 deaths among the commissioned employees during the year, as against 12 for the preceding twelve months.

CHANGES IN THE FORCE OF THE BUREAU.

CLASSIFIED SERVICE.

Appointments:	
Probationary—	
Printers, at $1,000	7
Clerk, at $1,000	1
Clerk, at $900	1
Copyist, at $840	1
Skilled artisans, at $840	2
Assistant observers, at $720	38
Repairmen, at $720	2
Watchmen, at $720	5
Folder and feeder, at $630	1
Messenger, at $600	1
Fireman, at $600	1
Messenger boys, at $450	6
Messenger boys, at $360	35
	101
Transfer—	
Printer, at $1,000	1
Copyist, at $840	1
	2
Reinstatement—	
Assistant observers, at $1,000	2
Assistant observers, at $720	2
Messenger, at $600	1
Messenger boy, at $480	1
	6
Temporary—	
Compositors, at $1,250	2
Clerk, at $900	1
Watchman, at $720	1
Folder and feeder, at $630	1
Messenger boys, at $600	3
Messenger boys, at $450	2
Messenger boys, at $360	26
Architect and superintendent of construction, at $180 a month	1
Evaporation observers, at $5 a day	2
Evaporation observers, at $2 a day	3
	42
Emergency—	
Clerk, at $1,000	1
Folders and feeders, at $720	3
Folders and feeders, at $630	2
	6

Promotions (all promotions except 2 were to the next higher grade or by certification for advancement from subclerical positions)	260
Reductions:	
Causes—	
To grant assignment to preferred station	2
Neglect of duty	3
Disobedience of instructions	1
Decreased efficiency due to increasing age	2
Unsatisfactory services	6
Unsatisfactory services and conduct	1
Failure to carry out agreement with the Bureau to settle a just account and unsatisfactory services	1
As an offset to the Bureau for allowance of quarters, fuel, and light	2
	18
Resignations:	
Voluntary	42
Required because of—	
Unsatisfactory services	4
Unsatisfactory services and conduct	2
Absence without authority	1
	49
Transferred to another Bureau in the Department of Agriculture	1
Removals:	
Causes—	
Misconduct	2
Absence without authority	3
Intemperance and absence without authority	1
Drunkenness, disobedience of orders, and use of foul language	1
Neglect of duty	2
Unsatisfactory services	1
Failure to answer official communication	1
Physical disability	1
	12
Dropped from the rolls at termination of probationary period because of unsatisfactory services	1
Deaths	2

UNCLASSIFIED SERVICE.

Appointments:	
Permanent—	
Unskilled laborer, at $720	1
Student assistants, at $300	5
	6
Temporary—	
Student assistant, at $300	1
Promotions (each to the next higher grade)	6
Resignations:	
Voluntary	4
Death	1

ABSENCE.

Average number of days per employee during calendar year 1908.

	Sickness.	Annual leave.
Station (99 per cent males)	1.5	6.8
Washington, D. C.:		
Males	5.2	24.9
Females	6.1	26.5
Entire service	2.6	11.9

STATISTICS OF THE SERVICE.

The following tables show the numerical strength of the Bureau and the highest, lowest, and average salaries paid in the commissioned grades:

Numerical strength of the Weather Bureau, June 30, 1909.

At Washington, D. C.:		
Classified	193	
Unclassified	11	
		204
Outside of Washington, D. C.:		
Classified	551	
Unclassified	17	
		568
Total commissioned employees		772
Additional employees outside of Washington, D. C.:		
Storm-warning displaymen	179	
River observers	400	
Cotton-region observers	143	
Corn and wheat region observers	134	
Rainfall observers	87	
Sugar and rice region observers	9	
Special meteorological observers	22	
Special cranberry-marsh observers	2	
Mountain snowfall observers	167	
Total noncommissioned employees		1,143
Total paid employees		[a] 1,915
Persons serving without compensation (except through the distribution of government publications):		
Cooperative observers and correspondents (omitting 351 paid and 6 cooperative observers enumerated elsewhere)	4,581	
Cooperative storm-warning displaymen	82	
Cooperative river observers	21	
Cooperative rainfall observers	11	
Total cooperatives		4,695
Total numerical strength		6,610

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[a] This total embraces all paid persons connected with the Bureau on June 30, 1909, except 14 commissioned employees absent on that date and who had been granted leaves of absence or furloughs without pay for one month or more.

Distribution of the commissioned force, June 30, 1909.

In Washington, D. C.:	
Accounts Division	[a]14
Climatological Division	15
Distributing Division	12
Executive branch	[a]17
Forecast Division	8
Instrument Division	10
Library	4
Marine Division	14
Observatory	10
Publications Division	36
River and Flood Service	2
Supplies Division	9
Telegraph Division	11
Verification Section	[b]2
Drafting room (under direction of the chief clerk)	3
Heat, light, and power plant (under direction of the chief clerk)	[c]5
Miscellaneous mechanical work (under direction of the chief clerk)	6
Watch force (under direction of the chief clerk)	6
General messenger and laborer service (under direction of the chief clerk	20
Total	204

Outside of Washington, D. C.:	
58 stations with 1 commissioned employee	58
51 stations with 2 commissioned employees	102
41 stations with 3 commissioned employees	123
20 stations with 4 commissioned employees	80
12 stations with 5 commissioned employees	60
7 stations with 6 commissioned employees	42
4 stations with 7 commissioned employees	28
2 stations with 8 commissioned employees	16
2 stations with 9 commissioned employees	18
3 stations with 10 commissioned employees	30
1 station with 17 commissioned employees	17
201 stations	[d]574

In addition to the foregoing there are eight special observing (one-man) stations in the West Indies, mainly in operation during the hurricane season, and a special repair station in Washington operated from October to April, inclusive.

The following salary table omits 4 evaporation observers, who receive pay only when they take observations, and persons on duty at special observing and substations where the salaries are $25 a month or less, and where, as a rule, the tour of duty covers but a small fraction of the day and only certain seasons of the year.

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[a] One employee devotes a portion of his time at one of the map stations at the United States Capitol.

[b] Heretofore assigned as part of the Forecast Division.

[c] Heretofore assigned as part of the Publications Division.

[d] This represents the normal station force. On June 30, 1909, there were actually on duty 568 employees.

Salaries paid in the commissioned grades.

Grades.	June 30, 1909.	
	Stations.	Washington, D. C.
Classified grades:		
Highest salary	$3,000	$5,000
Lowest salary	360	450
Average salary	1,041	1,149
Unclassified grades:		
Highest salary	720	720
Lowest salary	240	240
Average salary	374	496

Average salary of all (station and Washington) is $1,046.

REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

U. S. Department of Agriculture,
Bureau of Animal Industry,
Washington, D. C., November 18, 1909.

Sir: I have the honor to transmit herewith a report of the operations of the Bureau of Animal Industry for the fiscal year ended June 30, 1909.

Respectfully,
A. D. Melvin,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

ORGANIZATION AND ADMINISTRATION.

The lines of work carried on by the Bureau of Animal Industry during the fiscal year ended June 30, 1909, have been practically the same as in previous recent years, consisting of the meat inspection, the inspection of animals for export, the inspection and quarantine of imported animals, the eradication of diseases of live stock, the scientific investigation of such diseases, investigations in animal breeding and feeding, and work in the interest of the dairy industry and for the improvement of the milk supply.

The number of employees on the rolls of the Bureau July 1, 1909, was 3,268, an increase of 132 over the number a year before. Of these, 2,499 were engaged in meat inspection, an increase of 296.

While the work of the Bureau deals mainly with the live-stock industry, much of it operates at the same time for the protection of human health. Especially is this true of the meat inspection, the work for a more wholesome milk supply, and the study of animal diseases that may also affect man. The work is not and can not well be divided, however, according to the human and animal phases, as these are often intimately involved in a single problem or line of work. Even in the branches of the Bureau's work of which the protection of human health is an important object the problems must be attacked from the animal side.

The advantage and economy of the present organization of the Bureau in permitting the use of the same men in different lines of work and their transfer from time to time to meet the needs of the service was very strikingly shown in the work of the past year. In the emergency caused by an outbreak of contagious foot-and-mouth disease it was possible to draw immediately on a trained force of veterinarians and scientists already engaged in the regular work. Had the work been organized differently this would have been impracticable or impossible, and while a force was being organized the contagion would very probably have spread widely and have reached the great stock-raising regions of the West, where it would have caused tremendous damage and loss and where its eradication would have been exceedingly difficult and expensive. The regular field work in eradicating diseases of animals is mostly done during the summer, while the work of slaughterhouses is heaviest during the winter, and the same men can be utilized for field work in the summer and for meat inspection in the winter, thus effecting an economy which would not be possible if these lines of work were not under the same management. There is also a great advantage in the wide experience and training which the members of the force receive when their work is varied in this way.

After a general discussion of some of the more important subjects the work of the various divisions of the Bureau's organization will be presented in order and more in detail.

FOOT-AND-MOUTH DISEASE.

The principal event of the year, aside from the regular work of the Bureau, was the appearance of an outbreak of contagious foot-and-mouth disease and its eradication. The disease was first observed early in November, 1908, in a herd of cattle near Danville, Pa. The owner of the cattle had in his possession a report of the Bureau of Animal Industry containing an account of the outbreak of this disease in New England in 1902–3, including a description of the disease, and on comparing the symptoms in his cattle with this description he suspected the nature of the affection and called in a veterinarian. The cases were reported to the State veterinarian of Pennsylvania, who, after an examination, made a positive diagnosis and notified the United States Department of Agriculture on November 10. This diagnosis was confirmed a few days later by the Chief of this Bureau and by other members of the Bureau staff.

A quarantine was declared by the Secretary of Agriculture, effective November 13, against the interstate movement of animals from four counties in Pennsylvania in which the disease was reported. Within a few days cases were also found in several other counties in Pennsylvania and in the vicinity of Akron, N. Y., and on November 19 the quarantine was extended to include the entire territory of those two States.

On investigation it appeared that the disease was carried into Pennsylvania by cattle which came through the stock yards at Buffalo, N. Y., and that Buffalo was infected from Detroit, Mich. The State of Michigan was quarantined, effective November 25, and as the disease was also found a few days later near Lineboro, Carroll County, Md., just over the Pennsylvania border, a quarantine was placed on the State of Maryland on November 27.

The federal quarantine prohibited the interstate movement or the exportation of cattle, sheep, and other ruminants and swine from any of the States named. The shipment of hides, skins, hoofs, hay, straw, etc., was forbidden unless such material had been disinfected under the supervision of the Bureau.

The areas in which the disease was found are as follows: In Pennsylvania, the counties of Chester, Clinton, Dauphin, Delaware, Juniata, Lancaster, Lehigh, Lycoming, Montgomery, Montour, Northumberland, Philadelphia, Snyder, Union, and York; in New York, the counties of Erie, Genesee, Monroe, Niagara, and Orleans; in Michigan, the counties of Oakland and Wayne; in Maryland, Carroll County.

Promptly after the discovery of the disease in Pennsylvania an arrangement was made for cooperative work by the federal and state authorities for its eradication, and similar arrangements were later made with the authorities of the other affected States. The plan followed for stamping out the disease was practically the same as that which had been successful in the case of the New England outbreak of 1902–3, namely, to enforce a strict quarantine, to discover all infected animals and localities, and to slaughter and bury all diseased and exposed animals and disinfect the premises occupied by them. The owners of condemned animals were reimbursed to the extent of the appraised value, the Federal Government paying two-thirds of this amount and the State one-third. The expenses of burial, disinfection, etc., were shared in the same proportion.

Dr. S. E. Bennett, who had charge of the force of the Bureau of Animal Industry in the eradication of the New England outbreak six years before, was placed in charge of the federal work in Pennsylvania and Maryland, and Dr. U. G. Houck was put in charge in New York, and Dr. P. H. Mullowney in Michigan. The state work in Pennsylvania was carried on under the direction of the state veterinarian, Dr. Leonard Pearson; in New York, under the direction of Commissioner of Agriculture R. A. Pearson; in Michigan, under the direction of the state live-stock sanitary board, of which Mr. H. H. Hinds was chairman; and in Maryland, under the direction of Dr. F. H. Mackie, state veterinarian.

Besides the work of slaughter, burial, and disinfection, veterinary inspectors were sent to trace all rumors of foot-and-mouth disease and to locate any probable centers of infection. A large force was maintained in the infected regions, and thorough and systematic inspections and reinspections were made of all animals from farm to farm. The Bureau of Animal Industry had engaged in the work of inspection and eradication a total of 572 employees, of whom 159 were veterinarians. These inspectors made 108,683 visits to premises in 12 States, and the total number of animals inspected, including reinspections, was 1,565,699.

Slaughter of the diseased herds was begun just as soon as the necessary preliminary arrangements could be made, and the work of slaughter and disinfection was carried forward as rapidly as possible. The slaughtered animals were buried in deep trenches, the rule being to have the carcasses covered with at least 5 feet of earth. The work of disinfecting premises was difficult and tedious, but every effort was made to have it thorough and complete. So rapidly was the work prosecuted that by December 19, or within six weeks from the beginning, all diseased and exposed animals, so far as known up to that time, had been slaughtered and buried. The disinfection was done as promptly as possible after slaughter. A few additional infected herds were found later. The number of animals slaughtered, their appraised value, etc., are given in detail in the portion of this report dealing with the work of the Inspection Division.

The federal quarantine was modified and partly released from time to time as conditions warranted, and was entirely removed on April 24, 1909. In view of the experience with the New England outbreak, when additional cases of the disease were found several weeks after it was supposed that eradication was complete, it was considered wise to keep the quarantine in force until sufficient time had elapsed to make it practically certain that none of the infection remained.

The origin of the outbreak was at first a mystery. As the Bureau of Animal Industry maintained a strict quarantine on imported live stock, and as the importation of ruminants from countries where foot-and-mouth disease existed was prohibited entirely, it was considered highly improbable that the infection was brought into the country with imported animals, and various other ways in which it might have gained entrance were suggested. It soon became apparent, however, that the outbreak started near Detroit, and when the disease was traced by inspectors of the Bureau of Animal Industry to calves that had been used in propagating smallpox vaccine by a Detroit establishment it was considered highly probable that the vaccine was contaminated with the virus of foot-and-mouth disease and that this caused the outbreak. It was therefore decided to make a thorough investigation by scientific methods to determine whether or not contaminated vaccine virus was really the cause. As the United States Public Health and Marine-Hospital Service of the Treasury Department is charged by law with the supervision of biological products used in human medicine, that Service was requested to join this Bureau in making the proposed investigation, and the work was confided to Dr. John R. Mohler, chief of the Pathological Division of the Bureau of Animal Industry, and Dr. Milton J. Rosenau, director of the Hygienic Laboratory of the Public Health and Marine-Hospital Service. A full report of their investigation has been published as Circular 147 of the Bureau of Animal Industry.

By careful scientific methods Doctors Mohler and Rosenau were able to demonstrate that the smallpox vaccine virus of the Detroit establishment was in fact contaminated with the virus of foot-and-mouth disease. It appeared that this firm had obtained this particular strain of vaccine in May, 1908, from a firm in Pennsylvania, and tests with the vaccine of the latter firm showed that it was likewise contaminated. While it is not positively known just how long the contamination had existed at the Pennsylvania establishment, it seems probable that it was introduced with vaccine virus imported from Japan in 1902 and that the New England outbreak of that year originated from the same source.

The manner in which the disease was spread from the Detroit establishment was as follows: Certain calves, after having been used for the propagation of vaccine, were sent to the Detroit stock yards, where they remained two hours before being taken to a farm near the city. Four days later a shipment of healthy cattle from points in Michigan reached Detroit and was placed in the same pens that had been occupied by the vaccine calves. Some of these cattle were reshipped three days later to Buffalo and carried the contagion to the Buffalo yards. These animals, with others, were reshipped to Danville and Watsontown Pa., where the disease was later discovered.

As soon as the facts as to the contamination of the vaccine became known, immediate and effectual steps were taken by Surg. Gen.

Walter Wyman, of the Public Health and Marine-Hospital Service, to eradicate all this contaminated vaccine virus in America. After examining every strain of vaccine virus upon the market that Service has given assurance that there does not remain upon the market any vaccine virus contaminated with the virus of foot-and-mouth disease.

The cost to the Department of eradicating the outbreak was kept just within the appropriation of $300,000 made by Congress for that purpose, and if the disease had not been so promptly suppressed and if further cases had been found it would have been necessary to go to Congress for additional funds in order to continue the fight against the contagion. The authorities of the four affected States expended in their part of the work about $112,000. The loss to the dairy and stock-raising industries and to commerce was heavy. Not only was interstate traffic in live stock, hides, hay, straw, etc., interfered with, but exports to foreign countries, especially to Great Britain, were seriously curtailed.

The results have shown the wisdom of the rigorous slaughtering policy adopted in dealing with this outbreak. Such methods might be impracticable if the disease became so widespread that slaughter would involve the destruction of too large a part of the country's supply of live stock; but so long as the infection is restricted to a comparatively small part of the country's area there is no question that the slaughter policy is the best. To temporize with a restricted outbreak and rely entirely upon quarantine and treatment would very probably allow the infection to spread beyond control with disastrous results.

THE MEAT INSPECTION.

The meat inspection has continued to grow in volume and has reached the point where further extension is impossible without an increase in the appropriation by Congress. The expenditures on account of this work during the fiscal year amounted to about $2,884,000 out of the appropriation of $3,000,000. At the close of the year the rate of expenditure was higher than at the beginning, and it is now only by the strictest economy that the service can be maintained on its present basis without additional funds.

During the year there were inspected at the time of slaughter 55,672,075 animals, and of these there were condemned because of disease or other condition 141,057 entire carcasses and 899,628 parts of carcasses, making a total of over 1,000,000 animals condemned in whole or in part. In addition there were condemned on reinspection nearly 25,000,000 pounds of meat and meat products which had become unwholesome since inspection at the time of slaughter. More detailed figures relating to the meat inspection appear in the portion of this report dealing with the work of the Inspection Division.

With the additional authority given by the new law the Bureau has been able to bring about a steady improvement with respect to sanitation. New packing houses have been built so as to embody the best modern sanitary construction, and great improvement has been made in the sanitary condition of the older plants. The latter are being gradually abandoned for the erection of modern plants which may be kept at a proper standard of cleanliness with less labor and expense. As a result of this improvement there has been a considerable decrease in the amount of meat condemned because of insanitary conditions. It has also been found that where cleanly methods are employed there is much less reason for the use of preservatives than under the old conditions.

A constant effort has been made to keep the service at a high standard of efficiency and to make improvements wherever possible. Notwithstanding the efforts to give the public a reliable inspection, however, the service has been made the object of unjust attacks. Serious charges made against the service at East St. Louis by a former employee were carefully and thoroughly investigated and were found to be without any real foundation, but to have their origin in personal animosity. A full report of this investigation was published by the Department. In other cases the attacks have proved to be due to ignorance or misconception of the facts, a failure to understand the system of inspection, or a desire to cause sensation.

Thorough investigation of a number of reported cases of ptomaine poisoning attributed to inspected meat has failed to disclose a single instance in which the trouble could reasonably be ascribed to that cause. These investigations were undertaken largely because of assertions by manufacturers of preservatives to the effect that the enforced discontinuance of preservatives is responsible for a great increase in the number of cases of ptomaine poisoning. The Bureau has failed to find any justification for such arguments. In three cases of extensive outbreaks of illness in schools it was found that the trouble was really typhoid fever, and in one of these instances it appeared that the report of ptomaine poisoning was circulated with a view to concealing the real cause. Another report of a death from ptomaine poisoning from eating canned meat proved to have originated in the imagination of a newspaper correspondent, who acknowledged that it was untrue. The family had in fact eaten no canned meat, and the attending physician denied that there was any evidence of ptomaine poisoning.

There have been cases in which meat bearing the Federal inspection marks was alleged to have been condemned as unwholesome by city or local authorities. The fact is that the meat was sound at the time of being inspected and marked by the Federal inspectors and that the unwholesome condition arose afterwards. Everybody knows that meat is liable to spoil, and no inspection can guarantee that it will remain wholesome until consumed.

These instances are sufficient to show that credence should not be placed in published reports reflecting upon the meat inspection. The regulations are based not only upon the knowledge and experience of the Bureau staff, but upon the advice of high scientific authorities outside of the Department. The persons making up the inspection force are carefully selected through civil-service examination, and their work is closely supervised. One class of employees consists of veterinarians who are graduates of certain recognized colleges and who have a thorough knowledge of animal diseases and their relation to human health. Other employees are chosen because of their expert knowledge of live stock, meats, sanitation, packing-house processes, etc. There are seven supervisory traveling inspectors who visit the various stations from time to time, unannounced, and investigate the methods of carrying on the work. In this way it is extremely unlikely that inefficiency or corruption could remain undetected very long. In a work of such magnitude carried on by so many people, however, it is too much to expect absolute perfection. All men are liable to occasional errors of judgment, and in a force of 2,500 people there may even be a few who are incapable or unworthy. But even if it should happen on rare occasions that meat which should be condemned is passed, the amount is such an infinitesimal part of the entire quantity that it does not affect the value and integrity of the service as a whole. The large amount of meat actually condemned is good evidence of the care and thoroughness of the inspection.

There is, however, a real and serious danger to the public from uninspected meat, and almost half of the meat consumed in this country comes within that class. The Federal authority does not reach the business done entirely within a State, and the people must look to their State and local authorities to protect them against the danger from that source. One result of the Federal inspection is to cause the diversion of diseased and suspicious-looking animals to the uninspected establishments, where they are slaughtered for the local market. Many cities have an inspection service, but very few have a sufficient force of inspectors, and the inspection often consists merely in the examination of meat as offered for sale in the markets, when it is usually impossible to detect disease, the evidence of which may have been removed with the viscera or organs. As a rule sanitary conditions are very bad at uninspected slaughterhouses. In order to provide real protection against diseased and unwholesome meat a competent veterinary and sanitary inspection at the time of slaughter is essential. The great need for supplementing the federal inspection with state and municipal inspection was forcibly pointed out in a paper by Dr. A. M. Farrington, Assistant Chief of this Bureau, read at a convention of the Association of State and National Food and Dairy Departments and included in the Twenty-fifth Annual Report of the Bureau.

ERADICATION OF CATTLE TICKS.

The work of exterminating the ticks which spread so-called Texas fever of cattle in the South has been in progress for more than three years, and it is now possible to realize some of the benefits of this work. During the fiscal year there were released from quarantine as a result of the eradication of these ticks 13,544 square miles of territory, and since the beginning of the work in the summer of 1906 there have been released areas aggregating 71,336 square miles.

An investigation recently made by the Bureau in this territory shows that great improvement has already resulted from this work. More cattle are being raised, and a better grade of breeding stock is being introduced; calves grow faster, and cattle put on flesh more rapidly during the grazing season and go into the winter in better condition because of the absence of the ticks; they can be marketed without quarantine restrictions, and higher prices are being obtained; dairy cows give a larger yield of milk; and values of farm lands are enhanced. Aside from its own observations the Bureau has received from persons in the released territory numerous letters and other expressions confirming the foregoing facts and testifying to the great benefits following the extermination of the ticks.

The difference between the prices realized for cattle from the tick-infested region and the prices of cattle of similar grades from above the quarantine line ranges from $2.25 to $5 a head at the principal northern live-stock markets, without taking into account the improvement in quality and weight of cattle because of the eradication of the ticks. As more than 1,000,000 cattle from the quarantined area are annually sold in these markets, it can easily be seen that the extermination of the ticks means an annual increase of at least $3,000,000 in the prices obtained for southern cattle sold in northern markets. In addition to this, the increase in prices of cattle sold locally in the South would represent a large sum. This local increase has already been found to amount to from $3 to $15 a head in the territory recently freed from ticks. An agricultural official of one of the Southern States reports that calves in the tick-free area bring just double the price that can be obtained for similar calves in the tick-infested region.

Heretofore it has been impracticable to improve the quality of southern cattle by introducing fine breeding animals from other sections, because such animals were liable to contract Texas fever and die unless protected by inoculation. Furthermore, it is impossible for animals to attain good growth and to thrive when they are heavily infested with ticks. With the eradication of the ticks, however, the southern farmers are enabled to introduce good breeding animals and to improve the grade of their stock.

There is no longer any doubt that it is entirely practicable to exterminate the ticks throughout the entire region now infested by them, and the accomplishment of this result will be of tremendous economic advantage not only to the South but to the whole country. The rate of progress depends mainly on two factors—the amounts appropriated by the federal and state governments, and the cooperation of the people.

The work so far done by the Bureau has been in cooperation with state authorities, and the policy has been to work only in States and localities where the state and local authorities were prepared to assist and where public sentiment was favorable. Opposition has been encountered in some localities, but as the objects and benefits of the work are better understood this condition is being gradually overcome. In other sections there is a very cordial sentiment favorable to the work, and it is in such places that best results have been obtained. In sections where enough has been accomplished to demonstrate the advantages of tick eradication the people recognize the benefits, and in many instances hostility has given way to cordial approval. The Bureau is endeavoring to disseminate correct information as to the ticks, the disease which they spread, the damage which they cause, and the advantages of getting rid of them, by the distribution of publications, by lectures and addresses at farmers' institutes and other meetings, and by furnishing material to newspapers.

TUBERCULOSIS.

The Bureau has continued giving attention to the tuberculosis problem in its various aspects as it affects the live-stock industry and as the disease in animals affects the public health. Under authority contained in the agricultural appropriation act investigations have been continued to determine the prevalence and extent of this disease among dairy cattle in the United States. The tuberculin test was applied to numbers of cattle in several sections of the country by arrangement with the State and local authorities. Cattle were tested for interstate shipment to States requiring the tuberculin test as a condition of admitting dairy and breeding cattle, and assistance was also given to the authorities of many cities in testing cows furnishing milk to those cities. Out of 8,809 cattle tested with tuberculin during the year, 744, or 8.45 per cent, reacted as tuberculous. A much higher proportion of disease was found among dairy cows supplying milk to cities than among animals offered for interstate shipment, the proportion in the former class being about 14 per cent. Details of this work are given in the report of the Quarantine Division.

The Bureau has also continued its policy of reporting to state live-stock sanitary officers the names and addresses of owners and breeders of cattle and hogs found tuberculous in the meat inspection, and such reports were made to the authorities of 28 States during the fiscal year. By this means the state officials are enabled to locate centers of tuberculous infection and to take steps for stamping out the disease and preventing its spread.

It will be necessary to collect further information covering a much larger number of animals and a greater number of localities before the prevalence and extent of the disease in the United States can be accurately determined, but enough is known to show that tuberculosis exists to an alarming extent among the cattle and hogs of the country, especially among dairy cows, and that active steps should be taken to suppress it, both for the financial good of the stock owner and for the protection of the health of the people. A general campaign of eradication should perhaps be undertaken sooner or later, but this would be a task of great magnitude and would require heavy expenditures. In the meantime effective work can be done in a preliminary way to prevent the spread of disease and to eradicate it from certain herds and localities.

It should be remembered that tuberculosis is a contagious disease and must be considered and dealt with as such. With a proper understanding of its nature, each farmer and stock raiser can do much to prevent or eradicate the disease. In order to determine whether or not tuberculosis is present in a herd all the cattle should be tested with tuberculin, and if diseased animals are found they should be removed from the herd and the premises thoroughly disinfected. In case disease is found the herd should be again tested in about six months, in order to detect any new cases which may have been in the incubative stage at the time of the first test. If new cases are found on the second test, the premises should be again disinfected. All new cattle should be tested and if possible kept isolated for several months and again tested before being added to the herd.

Fairs and live-stock shows as at present conducted afford favorable conditions for the spread of tuberculosis. Cattle are brought together from various places, and there is frequently a considerable proportion of tuberculous animals among those exhibited. As a rule nothing is done by the management to determine whether or not animals offered for exhibition are healthy, and prizes are given indiscriminately to animals presenting the best appearance without regard to whether or not they are affected with tuberculosis. In my judgment the time has arrived when prizes should be given only to animals that are in a healthy condition, and the presence of tuberculosis or other contagious disease should constitute a disqualification. In fact, animals should not be admitted to such exhibitions at all unless their health is assured. An instance of the danger of the spread of tuberculosis through live-stock shows is afforded by the manner in which this disease is reported to have been introduced into the island of Guernsey. It seems that cattle from Guernsey that were exhibited in England, where the disease is prevalent, contracted the disease there, and after their return to Guernsey spread it among other animals.

The Bureau's scientific investigations relating to tuberculosis during the year are reviewed under the headings of the Pathological Division and the Experiment Station.

LIP-AND-LEG ULCERATION OF SHEEP IN THE NORTHWEST.

For many years a disease known to veterinarians as necrobacillosis has existed in a mild form in the United States, but until recently it has not threatened serious injury to the live-stock industry. During the past year, however, this disease has assumed a malignant form, known as lip-and-leg ulceration, in Wyoming and other Western States. The Bureau had a careful investigation made of the situation, and in order to check the spread of this virulent form of the disease and avoid serious injury to the sheep industry it was considered necessary to place a quarantine on the sheep in certain portions of Wyoming, which was done by the Secretary of Agriculture soon after the close of the fiscal year. The Bureau has studied methods of treatment of the diseased animals and has published a circular giving information on this subject. The milder forms of the disease yield readily to treatment, and it is believed that by the combined means of treatment and quarantine the infection may be suppressed.

PROPOSED PLAN FOR REPORTING DISEASES.

It is very important that the Bureau should keep constantly informed as to the appearance and prevalence of contagious diseases of live stock throughout the country, so as to deal with them promptly and effectively. At present such information is derived to some extent through Bureau employees, state officials, and general correspondence, but there is no regular and comprehensive plan of reporting. It is proposed to organize a system by which state live-stock authorities will be asked to cooperate with the Bureau by reporting promptly any outbreaks of contagious diseases and by forwarding regular monthly reports as to the existence and prevalence of such diseases in their respective States.

VETERINARY EDUCATION.

More than 800 veterinarians are engaged in the service of the Bureau, in connection with the meat inspection and the investigation and eradication of animal diseases, and it is of great importance that such men be well educated for this work. In the spring of 1908 a committee was appointed by the Secretary of Agriculture to investigate the courses of instruction at the various veterinary colleges in the United States and to make recommendations as to the instruction necessary to qualify graduates for admission to the civil-service examination for veterinary positions in the Bureau. This committee consisted of Dr. Richard P. Lyman, secretary of the American Veterinary Medical Association; Dr. Joseph Hughes, president of the Chicago Veterinary College; Dr. Tait Butler, secretary of the Association of Veterinary Faculties and Examining Boards of North America; Dr. Paul Fischer, state veterinarian of Ohio; and Dr. A. M. Farrington, Assistant Chief of the Bureau of Animal Industry.

After visiting the various veterinary colleges in the United States and one in Canada and collecting full information, the committee made a report with certain recommendations for the classification of the colleges and requirements for admission to the civil-service examinations. Following this report, another committee of members of the Bureau's staff, with Doctor Farrington as chairman, was appointed to continue the consideration of the subject and to formulate regulations governing entrance to the civil-service examination for veterinary positions in the Bureau. The latter committee recommended certain regulations, which were approved by the Secretary of Agriculture and the United States Civil Service Commission, under date of July 31, 1909, to take effect September 1.

While the Department claims no authority to regulate the affairs of the veterinary colleges, it is very much concerned in seeing that men are suitably educated for its service, and in conjunction with the Civil Service Commission it has a right to prescribe the requirements for admission to the civil-service examinations for such positions. As a rule the colleges have been disposed to meet the requirements of the regulations, and as a result it is believed that the standard of veterinary education in the United States will be considerably raised. In accordance with these regulations only persons who are graduates of colleges having a satisfactory course of instruction will be permitted to take the civil-service examination.

SUPERVISION OF VACCINES, SERUMS, ETC.

In accordance with the provisions of the act of Congress making appropriations for the Department of Agriculture for the past fiscal year, the Bureau has made tests of a number or serums, vaccines, tuberculins, and other preparations sold for the detection, prevention, or treatment of diseases of animals.

Tests made of a certain brand of imported hog-cholera vaccine and hog-cholera and swine-plague serum indicated that neither of these preparations is a reliable agent for protecting hogs from hog cholera. A domestic preparation, widely advertised and sold as a serum for the prevention of abortion in cows, was found on examination not to be a serum at all but to consist of a weak solution of carbolic acid. The results of the tests of these three preparations were published in Circulars 27 and 29 of the Secretary's Office.

An investigation was also made to test the potency of tetanus antitoxin prepared for veterinary use, it having become known in the veterinary profession that this antitoxin as prepared and sold by commercial firms was in many cases unreliable and far below the standard of strength. After examining quite a number of antitoxins prepared by various firms it was found that there is a great lack of uniform potency, the variation amounting in some instances to about two-thirds less than the strength which the antitoxin should possess. The results of this investigation have been published as Bulletin 121 of the Bureau. In strong contrast with the conditions regarding tetanus antitoxin for veterinary use, it appears that tetanus antitoxin for human use is reliable and accurately standardized in consequence of the stringent supervision exercised by the Public Health and Marine-Hospital Service in accordance with law.

The foregoing facts, together with the circumstances as to the introduction of foot-and-mouth disease through contaminated smallpox vaccine virus, show the urgent need for legislation by Congress giving to the Secretary of Agriculture adequate power to supervise and control biological products intended for the treatment of domestic animals, similar to the authority already conferred on the Public Health and Marine-Hospital Service with regard to such products used in human medicine. Under existing law the Secretary of Agriculture can only have tests made of such products as are found on the market and publish the results. There is constant danger that contagious diseases may be introduced from abroad and spread in this country through vaccines and serums for the control and treatment of animal diseases, and this danger increases with the growing use of such remedies in veterinary medicine. Such preparations as anthrax and blackleg vaccine, tetanus antitoxin, hog-cholera serum and vaccine, virus for the destruction of rats, besides tuberculin and mallein, are imported to a considerable extent and are liable to be contaminated with the contagion of some destructive animal disease prevailing in foreign countries. In order to protect our live-stock interests against the introduction of contagious diseases in this way, as well as to protect our farmers, stock raisers, and veterinarians against fraudulent and unreliable preparations, the Secretary of Agriculture should have the power to control the importation of such products and to supervise the preparation of those manufactured in this country for interstate commerce.

THE DAIRY INDUSTRY.

A valuable and important work for the dairy industry of the country is being done by the Bureau through its Dairy Division, and as a tangible economic result of this work there is effected a financial saving of many thousands of dollars annually, amounting to many times the cost of the service.

The average production of dairy cows in this country is far below what it should be, and there is no doubt that by systematic work in keeping records of individual cows, eliminating unprofitable ones, improving the quality of dairy stock, and the introduction of better methods, the average yield of the dairy cows in the country can be enormously increased. One important agency in accomplishing this is what are known as cow-testing associations, and during the year the Bureau has been active in promoting the formation of these associations. The keeping of records of dairy cows is advocated not only for the purpose of determining the value of each cow as a milk producer, but in order that the calves of the best cows may be kept and reared, as otherwise many animals that would be of great value in the dairy would be lost.

As a part of the general movement for more wholesome food the Bureau has continued to assist in bringing about the improvement of city milk supplies. This work has been done largely in cooperation with local health officers and through the use of the score-card system of dairy inspection, which affords an excellent means of determining actual conditions under which milk is produced and marketed, and in bringing about and measuring the improvement. On the basis of the score-card system an improvement of over 20 per cent in the sanitary condition of dairies has been observed during the past year as compared with the previous year in the work done in ten cities.

For three years work has been carried on in cooperation with state authorities for the development and improvement of the dairy industry in the South, and this work is already showing valuable practical results. The South consumes a much larger quantity of dairy products than it produces, yet it has fine natural advantages for a profitable dairy industry and should be able to produce a surplus. While much is needed in the way of a better class of cattle, improved methods, and more home-grown feed, the development of the dairy industry in the South is largely dependent upon the eradication of the cattle ticks, for which the Bureau is also working.

NEED FOR INSPECTION OF DAIRY ANIMALS AND PRODUCTS.

Investigations made by the Bureau show that in order to protect the health of consumers there is great need for the supervision and inspection of dairy products and of the animals from which they are obtained. The danger of contracting disease from such products is much greater than from meat, since milk, cream, and butter are almost universally used and are usually consumed in the raw state. Scientific experiments by the Bureau and by other investigators have demonstrated that the germs of tuberculosis and typhoid fever are frequently conveyed through dairy products, and that these germs may remain alive and virulent in milk beyond the time within which it is usually consumed, and in butter for several months.

Aside from the danger from contagious diseases, the sanitary conditions under which milk and butter are produced are often very bad and result in unwholesome products. While many creameries are in excellent sanitary condition, others are more or less filthy, and much of the cream that is made up into butter is shipped long distances in all kinds of weather and when received by the creamery is in a state of decomposition which renders it utterly unfit to go into a food product. Factories making renovated or "process" butter are now inspected by the Bureau under the requirement of an act of Congress, but there is no federal law giving authority for inspecting the creamery butter factories.

It is impossible to guard against unwholesome butter simply by an inspection of the finished product. Any inspection to be effective must deal with the milk and cream from which the butter is made, the health of the animals from which the milk is derived, the sanitary condition of the creamery, and the process of manufacture. It therefore seems highly desirable that legislation should be enacted by Congress providing for an adequate and efficient system of inspection at all plants where butter is manufactured for interstate shipment, for the control of interstate shipments of milk and cream, and for the inspection of animals and dairy establishments producing milk for interstate commerce.

PUBLICATIONS.

The large and increasing demand for the Bureau's publications gives evidence of the value and usefulness of this literature. During the fiscal year there were issued by the Bureau 111 new publications, aggregating 2,953 printed pages, besides numerous reprints of earlier publications. The new publications consisted of the Twenty-fourth Annual Report of the Bureau (for 1907), a revised edition of the Special Report on Diseases of Cattle, the annual report of the Chief of the Bureau for the previous fiscal year, 11 bulletins, 18 circulars, 8 Farmers' Bulletins, 5 reprints from annual reports of the Bureau, 2 Yearbook articles, 45 orders and amendments, and 19 miscellaneous publications. In addition the Twenty-fifth Annual Report of the Bureau (for 1908) has been prepared for publication.

THE INSPECTION DIVISION.

This division is under the direction of Dr. R. P. Steddom. The work consists of two main lines: (1) The meat inspection, and (2) the control and eradication of contagious diseases of animals.

THE MEAT INSPECTION.

A comparison of the meat-inspection work of the Bureau for the fiscal years 1908 and 1909 shows a steady growth. The only amendment to the regulations made during the fiscal year 1909 was that permitting the use of benzoate of soda as a preservative of meat or meat food product in conformity with the Department's ruling under the food and drugs act.

Four additional veterinary inspectors were assigned to travel and investigate the meat-inspection service at the various stations, making a total of seven inspectors so engaged.

Inspection was conducted during the year at 876 establishments located in 240 cities and towns, an increase of 89 establishments and 29 cities and towns as compared with the previous year. Inspection was inaugurated during the past year at 180 establishments and was withdrawn from 77 establishments, as compared with 137 establishments and 95 establishments, respectively, during the previous year. The cause of withdrawal in the majority of cases was that the establishment discontinued slaughtering or interstate business. Inspection was withdrawn from 5 establishments because of violation of the regulations and from 10 because of failure or inability to meet the sanitary or other requirements.

Below are shown the number of establishments and the number of cities and towns where inspection of meat and meat food products was conducted in each fiscal year since 1891.

Number of establishments and number of cities and towns where meat inspection has been conducted, fiscal years 1891 to 1909.

Year.	Establishments.	Cities and towns.
1891	9	6
1892	23	12
1893	37	16
1894	46	17
1895	55	19
1896	102	26
1897	128	33
1898	135	35
1899	139	42
1900	149	46
1901	157	52
1902	155	50
1903	156	50
1904	152	51
1905	151	52
1906	163	58
1907	708	186
1908	787	211
1909	876	240

During the fiscal year market inspection was extended to 4 more cities, making a total of 37 cities at whose public markets federal meat inspection is conducted in order that interstate deliveries may be made without violating the meat-inspection law and regulations.

ANTE-MORTEM INSPECTIONS.

The number of animals of each species inspected before slaughter is shown in the following statement, and indicates an increase of 4.6 per cent over the previous year:

Ante-mortem inspections of animals, fiscal year 1909.

Kind of animals.	Passed.	Suspected.[a]	Total.
Cattle	7,547,969	40,175	7,588,144
Calves	2,059,529	4,050	2,063,579
Sheep	10,990,274	2,305	10,992,579
Goats	69,882	1	69,883
Swine	35,808,887	22,665	35,831,552
Total	56,476,541	69,196	56,545,737

[a] This term is used to designate animals found diseased or suspected of being unfit for food on ante-mortem inspection, most of which are afterwards slaughtered under special supervision, the final disposition being determined on post-mortem inspection.

POST-MORTEM INSPECTION.

The inspections made at time of slaughter are shown in the following statement, which indicates an increase of 3.15 per cent over the post-mortem inspections made during the previous fiscal year:

Post-mortem inspections, fiscal year 1909.

Kind of animals.	Passed for food.	Passed for lard and tallow only.	Condemned.	Total.
Cattle	7,287,793	2,441	35,103	7,325,337
Calves	2,038,494	4	8,213	2,046,711
Sheep	10,792,078	78	10,747	10,802,903
Goats	69,111	....	82	69,193
Swine	35,244,005	97,014	86,912	35,427,931
Total	55,431,481	99,537	141,057	55,672,075

Included in the foregoing table are the post-mortem inspections of the carcasses of animals "suspected" on ante-mortem inspection, the final inspection of carcasses that were retained[a] at time of slaughter, and the carcasses of animals slaughtered without ante-mortem inspection and presented to official establishments with the head and viscera attached as required by Regulation 20.

The various diseases and conditions for which fresh carcasses and parts were condemned and tanked are shown in the following table:

Diseases and conditions for which condemnations were made on post-mortem inspection, fiscal year 1909.

Cause of condemnation.	Cattle.		Calves.		Swine.		Sheep.		Goats.	
	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.
Tuberculosis	24,525	40,148	177	151	45,113	791,735	21	1	......	......
Actinomycosis	589	44,440	......	69	......	......	......	......	......	......
Hog cholera	......	......	......	......	20,789	......	......	......	......	......
Septicemia, pyemia, and uremia	845	......	523	......	7,173	......	676	......	3	......
Pneumonia, pleurisy, enteritis, hepatitis, nephritis, metritis, etc	1,418	......	295	......	6,329	......	1,479	......	8	......
Icterus	60	......	45	......	1,623	......	862	......	18	......
Texas fever	427	......	775	......	......	......	......	......	......	......
Caseous lymphadenitis	......	......	......	......	......	......	1,023	7	8	......
Tumors and abscesses	107	5,989	28	43	1,178	1,609	102	37	......	......
Pregnacy and recent parturition	254	......	......	......	89	......	107	......	......	......
Injuries, bruises, etc	2,261	1,941	341	132	372	3,842	763	129	4	1
Immaturity	......	......	4,376	......	......	......	......	......	......	......
Sexual odor	......	......	......	......	1,031	......	......	......	......	......
Miscellaneous	4,617	7,221	1,653	14	3,215	2,114	5,714	5	41	......
Total	35,103	99,739	8,213	409	86,912	799,300	10,747	179	82	1

SUPERVISION OF PREPARATION OF MEATS AND PRODUCTS.

The amount of meats and meat food products prepared and processed under the supervision of the Bureau is given in the following statement, which shows an increase of 14 per cent over the previous year:

Meat and meat food products prepared and "processed" under Bureau supervision, fiscal year 1909.

Kind of product.	Weight.	Kind of product.	Weight.
	Pounds.		*Pounds.*
Beef placed in cure	223,248,347	Lard stearin	8,694,928
Pork placed in cure	2,686,051,091	Lard compound	16,029,644
All other classes placed in cure	3,459,072	Lard substitute	471,602,070
Sausage chopped	457,094,587	Bakers' compound	617,221
Canned beef	97,825,337	Oleo stock and edible tallow	51,742,603
Canned pork	23,725,342	Oleo oil	165,222,055
All other canned meats	2,259,506	Oleo stearin	78,924,616
Meat extract	445,921	Oleomargarin and butterine	91,068,350
Steam and kettle rendered lard	1,166,029,011	Miscellaneous products	1,095,075,749
Leaf lard	29,278,294		
Neutral lard	113,678,977	Total	6,791,437,032
Lard oil	9,364,111		

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[a] This term is applied to carcasses held on suspicion on first post-mortem examination, to be subjected later to more thorough examination for determining final disposition.

The following amounts of meat and meat food products were condemned on reinspection during the fiscal year: Beef, 13,216,568 pounds; pork, 11,285,323 pounds; mutton, 124,687 pounds; veal, 52,794 pounds; goat meat, 382 pounds; total, 24,679,754 pounds. The principal causes for condemnation were that the meat or product was found to be sour, tainted, putrid, unclean, or, in the case of fats, rancid. These condemnations show a decrease of 43 per cent from those of the previous fiscal year, which indicates improvement in methods of handling the products in sanitary conditions.

INTERCHANGE OF MEATS BETWEEN OFFICIAL ESTABLISHMENTS.

Considerable quantities of meats and meat food products that have been inspected and passed are transferred between official establishments, this traffic being closely supervised and the meats and products identified by means of marks and seals. During the fiscal year there were transferred in this manner the following amounts of meats and meat food products, part of which was contained in 22,616 sealed cars: Beef, 1,017,240,838 pounds; veal, 27,762,369 pounds; pork, 1,715,035,048 pounds; mutton, 43,637,107 pounds; goat meat, 54,609 pounds; total, 2,803,729,971 pounds.

MEATS AND PRODUCTS CERTIFIED FOR EXPORT.

The amounts of meat and meat food products certified by the Bureau for export are shown in the following table, being a decrease of 23.5 per cent as compared with the previous fiscal year:

Inspection certificates issued for export of meat and meat food products, fiscal year 1909.

Kind.	Number.	Beef.	Mutton.	Pork.	Total.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Regular	62,488	206,053,486	4,336,172	618,562,772	828,952,430
Preservative	41,744	3,147,964	....	349,709,256	352,857,220
Total	104,232	209,201,450	4,336,172	968,272,028	1,181,809,650

There were also issued 2,066 "inedible product" certificates covering the exportation of 19,307,140 pounds of such inedible products as hoofs, horns, casings, bladders, bungs, etc.

IMPORTED OLEOSTEARIN.

During the fiscal year 23,486,072 pounds of compound were manufactured from imported oleostearin under the Bureau's supervision at five establishments located at three seaport cities (Jersey City, New Orleans, and New York). This imported product is kept under lock while in official establishments, and no domestic meat food product is permitted to be mixed with it. The finished product is also kept under lock and is promptly loaded into vessels and exported without certificates or marks of federal inspection.

EXEMPTION FROM INSPECTION.

The provisions of the meat-inspection law requiring inspection do not apply to animals slaughtered by farmers on the farm nor to retail butchers and dealers. The Department requires that such butchers and dealers, in order to ship meats and meat food products in interstate commerce, shall first obtain certificates of exemption, but no such requirement is made of farmers. The number of certificates of exemption outstanding at the close of the fiscal year was 2,114, as against 2,477 at the close of the previous fiscal year, a net reduction of 363 certificates. During the greater part of the year five veterinarians have been kept on the road inspecting the plants and investigating the business of the holders of certificates. They made reports upon approximately 2,000 places, and as a result it was found necessary to call in and cancel 871 certificates of exemption. In the majority of these cases, however, the certificates were reissued later when business was resumed or required it, or when the insanitary conditions had been corrected.

During the year 120,088 shipments were made under certificates of exemption, covering 20,455,870 pounds of meat and meat food product. Over 90 per cent of the carcasses were veal.

INSPECTIONS FOR THE NAVY.

Upon request of the Navy Department, occasional inspections of meats and meat food products were made for the Navy during the year. These inspections were made at Baltimore, Boston, Brooklyn, Jersey City, New Orleans, Newport, Newport News, New York, Philadelphia, San Diego, San Francisco, and Washington. The meats and products inspected aggregated 3,288,163 pounds, of which 68,242 pounds were rejected. Rejections were made on account of the slimy, tainted condition of the product; also for underweight or overweight as required by the specifications and for the substitution of buck, heifer, or cow meat for the meat of wethers and steers, as specified.

CONTROL OF CONTAGIOUS DISEASES.

TEXAS OR SPLENETIC FEVER OF CATTLE.

The number of cattle shipped during the quarantine season of 1908 to northern markets from the area quarantined on account of Texas or splenetic fever of cattle was 1,141,804. These were carried in 39,994 cars, 38,085 of which were reported as being cleaned and disinfected under Bureau supervision. The number of cattle moved interstate from the provisionally quarantined area under certificates of inspection issued by Bureau inspectors was 215,867.

During the fiscal year 256,112 head of southern cattle were dipped in crude petroleum or otherwise treated under Bureau supervision for unrestricted movement, as provided in the regulations.

TICK ERADICATION.

The work of exterminating the ticks which spread the contagion of Texas fever of cattle has been continued, in cooperation with the various States interested. During the fiscal year areas were released from quarantine as follows:

State.	Square miles.	State.	Square miles.
Virginia	986	Arkansas	683
North Carolina	1,544	California	8,000
Tennessee	2,271		
Oklahoma	60	Total	13,544

A great deal of preliminary work was also done in several other States, as a result of which substantial progress has been made and further areas have been so far freed of ticks as to indicate that they may be released within a few months.

During the year the total number of inspections made by the Bureau employees was 3,202,871, of which 1,857,569 were reinspections.

SCABIES IN SHEEP.

The area quarantined for scabies in sheep was reduced during the fiscal year by releasing from quarantine the States of Kansas, Nebraska, Montana, North Dakota, and South Dakota. The number of inspections made by Bureau employees during the year was 59,762,512, a very slight increase over the number in the previous year. The number of dippings supervised by the Bureau during the year was 15,597,823, a decrease of 11.3 per cent.

The inspections and dippings of sheep for scabies and the number of cars cleaned and disinfected on account of that disease since 1900 are shown in the following table:

Inspections and dippings of sheep, and cars cleaned and disinfected, fiscal years 1900–1909.

Fiscal year.	Inspections.	Dippings.	Cars cleaned and disinfected.	Fiscal year.	Inspections.	Dippings.	Cars cleaned and disinfected.
1900	1,801,392	626,838		1905	53,680,786	16,873,659	7,965
1901	7,912,724	1,034,368		1906	59,246,288	12,396,976	8,625
1902	11,186,661	1,017,162	791	1907	62,625,831	12,133,466	6,275
1903	16,444,370	2,167,002	752	1908	59,471,141	17,589,578	9,338
1904	40,967,961	9,578,476	2,732	1909	59,762,512	15,597,823	4,981

SCABIES IN CATTLE.

The area quarantined for scabies in cattle was reduced during the fiscal year by releasing from quarantine areas of more than 60,000 square miles, comprising 12 counties in North Dakota, 6 counties and parts of 7 other counties in Colorado, 1 county and parts of 2 other counties in Oklahoma, 3 counties in New Mexico, and 10 counties in Kansas. The number of inspections made during the year was 17,656,934, an increase of 4.4 per cent over the previous year. The number of dippings supervised was 1,559,477, an increase of 2.1 per cent over the previous year.

The inspections and dippings of cattle for scabies and the number of cars disinfected on account of this disease since 1904 are shown in the following table:

Fiscal year.	Inspections.	Dippings.	Cars cleaned and disinfected.	Fiscal year.	Inspections.	Dippings.	Cars cleaned and disinfected.
1904	1,124,321	162,554	532	1907	15,243,323	466,623	15,009
1905	14,085,267	563,394	29,897	1908	16,920,100	1,527,280	17,601
1906	14,983,260	243,826	19,992	1909	17,656,934	1,559,477	11,607

SCABIES IN HORSES.

The number of horses and mules inspected for scabies during the year was 4,178, and the number dipped was 689.

FOOT-AND-MOUTH DISEASE.

The appearance of foot-and-mouth disease in Pennsylvania in the fall of 1908 required the quarantine of the counties of Columbia, Montour, Northumberland, and Union, effective November 13. This was followed by the quarantine, effective November 19, of the entire States of Pennsylvania and New York. The State of Michigan was quarantined effective November 25, and Maryland effective November 27. As soon as the infected area of each State was ascertained the remainder of the State was released from quarantine. In this way the uninfected portion of Maryland was released on December 19, of Michigan December 24, of New York December 29, and of Pennsylvania January 5.

All quarantine was raised from these States as follows: Maryland and Michigan, March 15; New York, March 26; Pennsylvania, April 24.

Following is a summary of the inspections made by Bureau employees in the work of eradicating this disease:

Inspections made by the Bureau of Animal Industry in the eradication of foot-and-mouth disease.

	Maryland.	Michigan.	New York.	Pennsylvania.	Miscellaneous.	Total.
Original inspections:						
Visits	3,754	7,304	14,784	44,869	238	70,949
Cattle	32,112	61,859	72,534	338,945	1,865	507,315
Hogs	27,407	38,722	46,736	256,136	....	369,001
Sheep	2,259	27,839	114,472	18,996	....	163,566
Goats	22	70	245	795	....	1,132
Total	61,800	128,490	233,987	614,872	1,865	1,041,014
Reinspections:						
Visits	1,130	1,089	9,964	24,967	584	37,734
Cattle	6,749	11,829	47,444	191,318	10,495	267,835
Hogs	6,181	5,102	29,801	119,395	1,769	162,248
Sheep	646	13,188	62,506	12,629	5,139	94,108
Goats	1	43	157	293	....	494
Total	13,577	30,162	139,908	323,635	17,403	524,685
Total visits	4,884	8,393	24,748	69,836	822	108,683
Total inspections	75,377	158,652	373,895	938,507	19,268	1,565,699

The extent of the infection found and the appraised value of the animals slaughtered are shown in the following summary:

Premises infected with foot-and-mouth disease, and number and appraised value of animals slaughtered.

	Maryland.	Michigan.	New York.	Pennsylvania.	Total.
Infected premises	2	9	45	101	157
Cattle:					
Number	31	242	520	1,232	2,025
Value	$1,066.20	$5,103.00	$20,622.25	$49,993.94	$76,785.39
Hogs:					
Number	60	23	246	1,000	1,329
Value	$562.63	$202.00	$2,388.38	$8,317.78	$11,470.79
Sheep:					
Number		9	214	52	275
Value		$45.00	$1,367.50	$346.50	$1,759.00
Goats:					
Number		3		4	7
Value		$9.00		$9.00	$18.00
Total animals	91	277	980	2,288	3,636
Total appraised value	$1,628.83	$5,359.00	$24,378.13	$58,667.22	$90,033.18

Two-thirds of the appraised value of the animals slaughtered was paid by the Federal Government and the remaining one-third by the respective States.

REPORTS OF VIOLATIONS OF LIVE-STOCK TRANSPORTATION LAW AND REGULATIONS.

During the fiscal year employees of the Bureau reported 300 cases of alleged violations of the twenty-eight-hour law. Alleged violations of the act of March 3, 1905, and of the regulations based thereon, were reported by Bureau employees during the year to the number of 243 cases. The information thus obtained was placed before the Department Solicitor, who in turn presented to the Department of Justice for prosecution such cases as were supported by sufficient evidence.

Many of the cases tried during the past year required special investigations and the collection of evidence by employees of the Bureau, who have cooperated with the United States district attorneys in charge of the cases in the federal courts.

THE QUARANTINE DIVISION.

The Quarantine Division is under the direction of Dr. R. W. Hickman. The work mainly relates to the imports and exports of live stock and the management of the Federal quarantine stations at the various ports of entry for imported animals.

INSPECTION OF VESSELS AND EXPORT ANIMALS.

Exports of cattle and sheep during the fiscal year show a considerable falling off, chiefly owing to the outbreak of foot-and-mouth disease. Because of this outbreak and the quarantine incident thereto, neither cattle nor sheep were exported from the ports of New York, Philadelphia, or Baltimore for several months.

During the fiscal year 473 inspections of vessels carrying live stock were made before clearance, in order to see that the regulations were complied with as to fittings, equipment, ventilation, feed, water, attendants, etc., and 818 certificates of inspection were issued for American cattle. The following table gives statistics of inspection of live animals for export during the year:

Inspections of American and Canadian animals for export, number tagged and rejected, and number exported, fiscal year 1909.

Kind of animals.	American.				Canadian.		
	Number of inspections.	Number rejected.	Number tagged.	Number exported.	Number inspected.	Number rejected.	Number exported.
Cattle	341,826	173	83,105	186,472	36,545	21	36,524
Sheep	36,628	5		21,000	14,398	11	14,387
Swine	1,718			1,718			
Horses	2,254	1		2,367			
Mules	816			816			
Asses	2			2			
Total	383,244	179	83,105	212,375	50,943	32	50,911

Most of the animals, exclusive of swine, included in the above statement were shipped to Great Britain, namely, of American animals, 184,159 cattle, 19,868 sheep, and 1,308 horses, and of Canadian animals, 36,459 cattle and 14,387 sheep.

The inspection of vessels carrying export cattle and the enforcement of the regulations referred to continue to result in an exceedingly low percentage of losses of animals in transit. Statistics of animals landed at three principal British ports show that only 0.10 per cent of the cattle, 0.38 per cent of the horses, and 0.62 per cent of the sheep were lost at sea.

During the fiscal year 9,755 horses were inspected by Bureau veterinarians for shipment to Canada, 52 of which were rejected on account of reacting to the mallein test.

There were also inspected for exportation to Canada 4,914 cattle, 11 hogs, and 1 goat. Of the cattle there were tested with tuberculin 317, of which 5 reacted and were rejected.

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

In order to protect the live stock of the United States from contagion that is liable to be introduced with animals from other countries, the regulations require that all horses, cattle, sheep, and other ruminants, and swine imported into the United States must be inspected before they are admitted, and, in addition, that all ruminants and swine from any part of the world except North America shall be quarantined. For the importation of animals for which quarantine is required, a permit (in duplicate) must be procured from the Secretary of Agriculture prior to shipment. Importations are not permitted at all from some parts of the world where destructive diseases of animals prevail.

The following tables show the number of imported animals inspected and quarantined and the number inspected but not quarantined during the fiscal year:

Number of imported animals inspected and quarantined, fiscal year 1909.

Ports of entry.	Cattle.	Sheep.	Swine.	Goats.	Other animals.
New York	494	157	1	3	94
Boston	81	12			
Baltimore	9	19	7		
Canadian border ports	156	3,721	5		1
Total	740	3,909	13	3	95

Number of imported animals inspected but not quarantined, fiscal year 1909.

Ports of entry.	Cattle.	Sheep.	Swine.	Horses.	Mules and asses.	Goats.	Other animals.
New York				3,685	59		2
Boston				223	4		
Philadelphia				33	1		
Baltimore				93			
New Orleans				1,293	1,287		
Portland, Me				80			
Mexican border ports	129,539	5,232	850	830	830	147	20
Canadian border ports	5,337	79,496	126	3,767	85	7	18
Total	134,876	84,728	976	10,004	2,266	154	40

TUBERCULIN TEST IN GREAT BRITAIN.

The regulations governing the importation of animals subject to inspection and quarantine provide that all cattle 6 months old or over imported from Great Britain, Ireland, and the Channel Islands shall be tested with tuberculin by an inspector of the Bureau of Animal Industry before being exported or after arrival at the animal quarantine station at the port of entry. The following table shows the results of such tests made in Great Britain during the fiscal year:

Results of tuberculin tests in Great Britain of cattle for importation, fiscal year 1909.

Breed.	Passed.	Failed.
Aberdeen-Angus	53	4
Ayrshire	[a] 32	4
Dexter-Kerry	33	3
Guernsey	334	3
Jersey	[b] 229	
Shorthorn	14	4
Total	695	18

[a] Seventeen of these were for shipment to the United States via Canada.
[b] Seventy-seven of these were for shipment to the United States via Canada.

PREVALENCE AND EXTENT OF TUBERCULOSIS.

In accordance with a provision in the act of Congress making appropriations for the Department of Agriculture for the past fiscal year by which the Secretary of Agriculture was authorized "to investigate the prevalence and extent of tuberculosis among dairy cattle in the United States," steps were taken to collect such information by applying the tuberculin test to cattle in various parts of the country. The outbreak of foot-and-mouth disease interfered somewhat with this work, it being found necessary to transfer a number of men temporarily from the work of tuberculin testing to that of eradicating foot-and-mouth disease.

Many States require the tuberculin test as a prerequisite for the admittance of dairy and breeding cattle from other States, and ten additional States adopted this requirement during the fiscal year. Cooperative arrangements were made with the authorities of a number of States for the application of the tuberculin test to cattle for interstate shipment. This work was carried on during the fiscal year at the places and with the results shown in the following table:

Results of tuberculin testing of dairy and breeding cattle offered for interstate shipment during the fiscal year 1909.

Place.	Number of cattle tested.	Number passed.	Number reacting.	Number of suspects.	Percentage of reactors and suspects.
Denver, Colo	57	55	2	0	3.50
Lancaster, Pa	1,696	1,629	41	26	3.95
Minnesota Transfer, Minn	1,322	1,299	23	0	1.74
Portland, Oreg	135	127	8	0	5.92
Salt Lake City, Utah	161	137	16	8	14.91
Sioux City, Iowa	78	78	0	0	.00
South Omaha, Nebr	69	65	3	1	4.35
South St. Paul, Minn	114	114	0	0	.00
Total	3,632	3,504	93	35	3.53

The testing is being continued at nearly all of these points.

The tuberculin testing of cattle in Virginia, Maryland, and the District of Columbia, in connection with the cooperative work with the authorities of the District of Columbia for the improvement of the milk supply of the city of Washington, was continued, but was suspended from November, 1908, until April, 1909, owing to the outbreak of foot-and-mouth disease, already referred to. The results of this work for the fiscal year 1909, and also from its beginning in 1907, are shown in the following table:

Results of tuberculin testing of dairy cattle in Virginia, Maryland, and the District of Columbia supplying milk to the city of Washington.

Period and items.	Number of cattle tested.	Number passed.	Number reacting.	Number of suspects.	Percentage of reactors and suspects.
From July 1, 1908, to June 30, 1909:					
Cattle not previously tested	378	324	47	7	14.28
Annual retests	1,467	1,331	125	11	9.27
Total	1,845	1,655	172	18	10.29
From the beginning of the work in 1907 to June 30, 1909:					
Cattle not previously tested	2,471	2,094	350	27	15.25
Annual retests	1,729	1,563	153	13	9.60
Total	4,200	3,657	503	40	12.93

The Bureau has also applied the tuberculin test to dairy cattle in various parts of Nebraska in cooperation with the state authorities, and especially to assist the city of Omaha in obtaining a milk supply free from tuberculosis, with the following results:

Number of cattle tested	2, 652
Number apparently free from tuberculosis	2, 317
Number which reacted to the tests	335
Percentage of reactors	12. 63

The city of Waterloo, Iowa, having passed an ordinance requiring that all milk sold in the city must be obtained from cattle which are free from tuberculosis, and the assistance of the Bureau having been requested, the Bureau is cooperating with the city and state authorities in testing dairy cattle. From the inception of the work, May 24, 1909, to the close of the fiscal year the results have been as follows:

Number of cattle tested	680
Number apparently free from tuberculosis	589
Number which reacted to the tests	91
Percentage of reactors	13. 38

The following is a summary of all the tests made by the Bureau during the fiscal year in connection with this work at various places throughout the country as above set forth:

Number of cattle tested	8, 809
Number found free from tuberculosis	8, 065
Number of reactors and suspects	744
Percentage of reactors and suspects	8. 45

An investigation of the milk supply of the various United States Government Indian schools from the standpoint of tuberculosis and sanitary conditions is also in progress. During the year investigations have been made at the Indian schools at Carlisle, Pa.; Stewart, Nev.; Chamberlain, S. Dak.; Green Bay, Wis.; Lawrence, Kans.; Hayward, Wis.; Lac du Flambeau, Wis.; Lapwai, Idaho; Phoenix, Ariz.; Rapid City, N. Dak.; and at the Canton (S. Dak.) Indian insane asylum.

An effort has also been made to locate centers of tuberculous infection by tracing the origin of cattle and hogs that are found affected with tuberculosis, through the meat inspection. The names and addresses of the former owners or feeders of such animals are obtained when possible, and notification of the finding of tuberculosis is sent to those persons and to the state live-stock sanitary officers. This has been a means of enabling the state authorities to locate centers of tuberculous infection and to undertake measures in cooperation with the owners for the eradication of the disease from the remaining animals.

During the fiscal year the Bureau reported in this way cases of tuberculosis in 1,243 cattle from 342 premises and in 4,348 hogs from 630 premises in 28 States in various parts of the country.

ANTHRAX IN SOUTH DAKOTA.

Early in the fiscal year anthrax in domestic animals was reported in the southwestern portion of South Dakota. Investigation revealed a serious outbreak, and cooperation with the state live-stock authorities was immediately established. Incineration of the carcasses was quite generally carried out, and in some sections commercial vaccines were used with the object of assisting the quarantine and sanitary measures in preventing a further spread of the disease. The outbreak continued for about four months, and the deaths of cattle numbered about 1,200 and of hogs about 250. The losses of horses and sheep were slight.

LIVE-STOCK DISEASES AND CONDITIONS IN PORTO RICO.

Dr. Thomas A. Allen, Bureau inspector in Porto Rico, made a tour of investigation of the diseases of animals in that island, and confirmed the report previously made by Dr. William Thompson to the effect that the cattle all over the island are more or less infected with ticks. The majority of stockmen interviewed expressed the opinion that in so far as native cattle are concerned the ticks do not cause many deaths, although in the case of animals that are in low condition, hard worked, and on poor pastures, they cause fever and death in many instances. It is the general opinion that ticks do more or less harm in all cases, especially so in reducing the flesh and the milk secretion of cows and in the loss of flesh and strength in work animals. There are very few American cattle on the island, nearly all those that have been brought there having died of tick fever. Many stock owners recognize the harmful effects of the ticks and are using various kinds of treatment. The Bureau is endeavoring to encourage systematic work in tick eradication by advising the stockmen.

Twenty-one head of tuberculin-tested Jersey cattle were purchased in the vicinity of San Antonio, Tex., and shipped to Porto Rico from New Orleans in April, for the agricultural farm of the University of Porto Rico at Mayaguez. All of the cattle arrived in good health. They were more or less infested with ticks of various sizes, but measures were taken to free them from ticks. These animals are believed to be immune to tick fever, and it seems that only such animals—that is, cattle from the tick-infested area of the United States—can be safely taken to Porto Rico.

THE PATHOLOGICAL DIVISION.

The pathological work of the Bureau is under the direction of Dr. John R. Mohler. It consists mainly in the scientific investigation of animal diseases, and during the past year the principal routine work was, as formerly, in connection with tuberculosis, blackleg, glanders, and rabies.

The preparation of an exhibition of tuberculous specimens by the Bureau for the International Congress on Tuberculosis, which was held in Washington in September, 1908, and the appearance of foot-and-mouth disease in Michigan, New York, Pennsylvania, and Maryland, entailed upon this division a large amount of work during the past year in addition to its regular operations. Notwithstanding the extra work required in these two instances, numerous investigations were made of several infectious diseases, brief outlines of which follow.

INFECTIOUS OPHTHALMIA IN CATTLE.

This affection was observed in the Cincinnati stock yards in a carload of cattle, and after their slaughter the eyes were forwarded to the pathological laboratory for confirmation of the diagnosis. In all of the 18 eyes which were received an opacity of the cornea was noted, accompanied by erosions. In two cases perforations were present. The bacterioscopic examination of the ulcers and aqueous humor showed the presence of a diplococcus which was also obtained in the growths upon various culture media. In all instances where the inoculation was made from the aqueous humor a pure culture of the organism was obtained from the growth. Experimental inoculations were made with the pure cultures of this organism on rabbits and calves, but it was not possible to transmit the disease in all instances. A rabbit in which the conjunctiva was slightly scarified received one drop of the bouillon culture into the eye, and as a result a conjunctivitis with a slight opacity of the cornea developed, which, however, disappeared after a few days without any further interference. A calf was given an intraocular inoculation of one drop of the bouillon culture, which caused a severe conjunctivitis and keratitis, with extensive ulceration of the cornea, resulting in the loss of the sight. Into the other eye of the same calf two loopfuls of the bouillon culture were smeared over the inside of the eyelids, producing only a slight conjunctivitis and photophobia, without any other complications. Other calves were also inoculated with older cultures of the same organism in different ways, but no typical lesions of the affection were obtained. Further work upon this disease will be conducted as soon as fresh material is available.

PARALYSIS OF PREGNANT EWES IN THE SOUTHWEST.

Numerous reports having been sent to the Bureau from New Mexico and Arizona of trouble with sheep just before lambing, an investigation was made during the winter of 1908 in an effort to determine the cause. It was found that the ewes were attacked from a few days to two weeks prior to lambing. They are first affected with tremors and disordered vision. The disease progresses rapidly. Staggering gait and lack of coordination are followed by inability to rise and a condition of more or less complete coma. The paralysis becomes gradually more complete, and after the animal has lingered five to ten days in this helpless state death ensues. The ewes show no tendency to abort, in spite of the severity of the symptoms. Only the fattest and thriftiest members of the flock are affected.

Since the disease closely simulates parturient apoplexy in cows, the inflation of the udder with air seems indicated. This treatment can not be unconditionally recommended at present, however, because of the small number of ewes upon which any form of treatment could be applied during this investigation.

CHRONIC BACTERIAL DYSENTERY.

During the past year the Pathological Division received several specimens showing the characteristic lesions of chronic bacterial dysentery or Johne's disease. The specimens originated in the States of California and Oregon, and the veterinary inspector who investigated the outbreak in Oregon could trace the origin of the infection to a cow imported from the Island of Jersey, where the disease is quite prevalent. The specimens from the outbreak in Oregon arrived in excellent condition for investigation purposes, and afforded a good opportunity to study the pathology of the disease and also to try to grow on various culture media the acid-fast organism causing the disease. No growths were obtained on the ordinary media, but on egg strata a luxuriant growth developed of the acid-fast organism in the form of a raised colony, while the entire surface of the medium was grown over with a saprophytic organism (*Bacillus prodigiosus*). It was then attempted to isolate the organism on egg plates. This, however, was not successful, as before any of the colonies of the acid-fast organism would develop the entire plates were covered with the saprophytic organism. Several such attempts at isolation remained fruitless. It was then deemed advisable to obtain additional fresh specimens for further investigations, and accordingly inspectors in the field were requested to forward specimens of this disease to the laboratory whenever it should come under their observation.

IMMATURE CALVES (BOB VEAL).

The enforcement of the meat-inspection law resulted in the prosecution, and finally the conviction, of several persons shipping, receiving, and offering for sale immature calves, commonly known as "bob veal." Several members of the Pathological Division were detailed to furnish expert testimony before the United States courts and federal juries as to the physiological and pathological conditions of immature veal and the deleterious effect which the consumption of this obnoxious food would exert upon the human system.

AN AFFECTION OF THE LIVER IN CATTLE.

The condition known as telangiectasis of the liver in cattle has been referred to as hemorrhagic spotting and angioma and is quite frequently met with on the killing floors of the various slaughtering establishments in this country, in some instances affecting as many as 25 per cent of the livers.

In cases where the liver is only slightly affected it is normal in size and color, with a few hemorrhagic areas scattered here and there throughout its substance. These areas are readily seen through the capsule, ranging in size from one-sixteenth to one-fourth of an inch in diameter. In more extensive cases the areas are from one-fourth to one-half inch in diameter or even larger. They vary from dark red to purple and some may be bluish black in color; in the latter cases there is usually a moderate hypertrophy of the organ. Where the areas are superficial, Glisson's capsule seems to be depressed, and on passing the hand over the surface of the organ the affected spots seem softer than the surrounding liver tissue.

On section the hemorrhagic areas are usually more numerous in the central and right portion of the organ, but occasionally the hemorrhages are uniformly scattered in a somewhat even manner throughout the entire organ, having apparently no relation to the blood vessels or hepatic ducts. The contents of the incised areas are soft in consistency, resembling splenic pulp. Blood, mixed with a little of the pulp, exudes slowly if pressure be applied, and some of the broken-down tissue and bloody fluid is forced out, leaving a depression with irregular margins. In some cases the hemorrhagic areas become confluent, resulting in the complete destruction of large areas of the hepatic tissue, 1 or 2 inches in diameter. In such cases the degree of hypertrophy is usually great; such livers are often three or four times their normal size and may weigh as much as 40 pounds.

PSEUDO-LEUKEMIA IN HOGS.

Many specimens of enlarged lymphatic glands of hogs have been received at the laboratory of the Pathological Division during the past year which have been diagnosed as pseudo-leukemia or Hodgkin's disease. On post-mortem examination the disease manifests itself by enlarged soft or hard lymph glands, often showing hemorrhagic areas. The glands in this affection do not all become involved at the same time; generally the cervical and other body glands are first to become enlarged, followed by the visceral glands. The spleen, liver, and kidneys may then become attacked and in extensive affections the submucosa and serosa are affected, the lungs remaining free. The post-mortem notes forwarded by inspectors with the specimens show that in the greater number of cases macroscopic lesions were found in body glands only. Histologically such glands showed a hyperplasia of the connective-tissue structures, hemorrhages, and in most cases a marked diminution of leucocytes and small lymphoid cells due in these cases to fatty infiltration of the liver and other organs. There were present, however, an abundance of epithelioid and eosiniphilic cells. When the spleen is involved it also shows an intense increase of the connective-tissue formations. If portions of the body are involved where the lymphoid elements are normally not conspicuous, the abundance of lymphoid structures is the principal manifestation.

This disease in hogs is especially important, since it resembles tuberculosis of the lymph glands to a certain degree, and has often been diagnosed as such, but in no instance could the tubercle bacillus be demonstrated in smears, nor did any of the experimental animals show lesions of tuberculosis upon inoculation. The fact that body glands are affected when visceral glands and organs remain normal, and the absence of any caseation or calcification in the diseased glands, should be of aid in differentiating Hodgkin's disease from tuberculosis.

INVESTIGATIONS OF COTTON-SEED MEAL.

Investigations are being made to determine the cause of injury to live stock by the feeding of cotton-seed meal. The physiological work has shown that cotton-seed meal owes its injurious action to a definite chemical substance, and this substance when fed artificially will produce chronic emaciation in laboratory animals. This active principle has been found to exist in two forms, one harmless and inactive, and the second a poisonous variety.

Cotton seeds of this country are known to be of two main varieties. One of these, when fed in the laboratory, seemed to be harmless, while the other induced death, the same as the meal of commerce. The harmless variety of seeds could be rendered poisonous by the same simple chemical procedure which converts the harmless variety of the active principle of the meal into the poisonous form. A meal apparently harmless to animals can be made in the laboratory, but factory conditions have not yet been tried. The prospects for making harmless meal of the less toxic variety of seeds are very promising, but as yet no method has been developed for converting the poisonous seeds into a harmless meal. This is a problem in plant physiology.

The study of cotton-seed meal would lead to the study of the action of pressed cakes, such as those made from peanuts, which are believed to cause poisoning in stock. The important problem which logically follows from this work is the study of the supposed poisonous action on animals of diseased corn, also of its relation to pellagra and to so-called forage poisoning of horses as well as of the relation of fagopyrismus to buckwheat poisoning.

DISEASES OF POULTRY AND OTHER BIRDS.

The importance of protozoa as causative factors in the production of enteritis in poultry is becoming more apparent, both coccidia and cercomonads being responsible for this condition. Several outbreaks of intestinal cercomoniasis have been studied, and points of differentiation at autopsy between this and intestinal coccidiosis have been recognized. There have also been an unusually large number of cases of death caused by the presence of the air-sac mite, some of the cases having gone on to the development of a typical acarian pneumonia, the lungs revealing scattered foci of inflammation, each of which contained at its center the mite *Cytodites nudus*. A diseased condition in golden pheasants, which has hitherto been described only by Galli-Valerio in 1897 and by Letulle and Marotel in 1901, was found. This affection is a parasitic nodular disease caused by the encystment of the larvæ of *Heterakis papillosa* in the submucosa of the walls of the ceca.

AUTOPSIES ON ANIMALS FROM NATIONAL ZOOLOGICAL PARK.

During the past fiscal year autopsies have been held on 126 cases of wild animals, including mammals, birds, and reptiles from the National Zoological Park. The principal diseases found on post-mortem and the species affected were as follows: Gastro-enteritis, 23 cases, affecting deer, fox, beaver, monkey, seal, parrot, owl, toucan, tinamou, and jaguarondi; pneumonia, 21 cases, affecting elk, deer, fox, kangaroo, otter, beaver, lynx, baboon, aoudad, armadillo, heron, parrot, and toucan; tuberculosis, 16 cases, in monkey, baboon, mountain goat, kangaroo, crane, owl, capybara, and cacomistle; pulmonary congestion, 7 cases, in American bison, deer, antelope, crocodile, and bob-white; intestinal parasites, 7 cases, in lynx, monkey, jaguarondi, rattlesnake, and cormorant; traumatisms or injuries, 7 cases, in tiger, monkey, owl, stork, macaw, and curassow; aspergillosis, 6 cases, affecting flamingo, pigeon, duck, tinamou, and toucan; bacillary infection, 5 cases, in snakes; mechanical obstruction of the intestine, 5 cases, in snake, crested screamer, and cariama; nephritis, 5 cases, in monkey, deer, and fishing cat; peritonitis, 4 cases, in water buffalo, snake, duck, and leopard; pericarditis, 1 case, in a deer; rabies, 3 cases, all occurring in dingo dogs.

LEUCOCYTES IN MILK.

The number of leucocytes in milk and their significance are receiving the serious attention of those bacteriologists who are striving for a pure milk supply. The question as to what number of leucocytes should be regarded as abnormal is still the subject of investigation. The opinions of contemporary workers are becoming more uniform as the methods for the determination of these leucocytes are reaching greater efficiency. Previously it was considered that but few leucocytes were contained in the milk of healthy cows and that when a certain increased number of leucocytes were observed it was suggestive of inflammation of the udder. However, with the technique usually employed in the numerical determination of leucocytes there is too narrow a margin between the number of leucocytes found in the milk of healthy cows and in that of diseased cows to make this form of diagnosis satisfactory and practicable. With a view of obtaining more uniform results which would aid in establishing a standard, this Bureau, in cooperation with the Pennsylvania live-stock sanitary board, undertook some experiments in accordance with the improved technique recommended by Russell and Hoffman for the determination of the leucocyte content of milk. These experiments, reported in Bulletin 117 of this Bureau by Dr. H. C. Campbell, have opened up an interesting line of investigation, and the limits of lactic leucocytosis which have been adopted by some States based upon the old standards should be modified accordingly.

NECROBACILLOSIS IN SHEEP.

During the past year outbreaks of necrobacillosis among sheep have been so frequently reported to exist in alarming forms in portions of Wyoming and Montana that on several occasions members of the Pathological Division have been dispatched to the infected districts to study the various forms of the disease and to advise the stockmen as to the best means of combating it. It has long been established by this Bureau that necrobacillosis is caused by the *Bacillus necrophorus.* The disease manifests itself in various parts of the body by inflammation, tumefaction, ulceration, and necrosis with scab formation. The extent and size of the pathological changes vary from a papule to an extensive necrotic area. This disease assumes various manifestations, although the lesions are most often located on the lips, face, and skin of the legs; hence the names of lip-and-leg ulceration and necrotic dermatitis have been applied. Less often the affection spreads into the mouth, producing necrotic stomatitis. In some cases the necrosis extends over the nose and between the eyes, at times producing a muco-purulent discharge. The venereal form was found prevalent in the southeastern portion of Montana and in nine counties in Wyoming.

The treatment of this disease is very satisfactory if begun during the early stages and thoroughly applied. Separation of the uninfected sheep from the affected ones, treating the apparently uninfected sheep as exposed and dipping them prior to their being turned upon uninfected pastures or premises, the dipping of affected sheep after having received local treatment and recovered, cleansing and disinfecting contaminated pens, sheds, corrals, etc., have been found necessary in order to rid an infected section of this malady. Several applications of a 30 per cent solution of hydrogen peroxid after removing the scabs, or emollient dressings, such as 5 per cent of one of the cresol or coal-tar creosote sheep dips in vaseline or lard, have given good results if energetically applied. Advanced and aggravated cases require a more penetrating and caustic preparation. For this purpose 1 part of nitric acid to 7 parts of water applied to necrotic and fungoid appearing areas has been found very efficacious.

ERRONEOUS REPORTS OF FOOT-AND-MOUTH DISEASE.

During the recent outbreak of foot-and-mouth disease in this country many reports of the existence of the disease in various States were received which proved to be erroneous. Members of the Pathological Division who were detailed to ascertain the condition of the animals in these localities found stomatitis of various degrees, due to mycotic and bacillary infection, eruption of teeth, coarse feeding, and traumatisms, but in no instance did the trouble prove to be foot-and-mouth disease.

The alarm regarding foot-and-mouth disease even extended to neighboring island provinces, and a report reached the Bureau that it had appeared in Jamaica. Because of its commercial importance this reported outbreak demanded immediate investigation, and a member of the pathological force was dispatched to the scene of the trouble. On arrival he made some inoculations of sound animals for diagnostic purposes. None of these inoculations proving positive, it became evident that the outbreak was not of an infectious character and could not therefore have any effect upon international commerce.

RABIES.

During the fiscal year 153 animals suspected of being affected with rabies were sent to the pathological laboratory, in order that a definite diagnosis might be made. Of this number it was found that 104 were rabid and 49 were not affected with rabies. This large number of rabid animals, mainly originating in the District of Columbia or its immediate vicinity, offers conclusive evidence of the imperative need which has existed during the past year in this region for legal enactment providing for the better control of dogs and for the destruction of all that are not subjected to such control. The number of rabid dogs in the District is now somewhat less than it was a year ago, but the disease will undoubtedly remain until suitable requirements for the muzzling of dogs are rigidly enforced.

The positive cases of rabies diagnosed by the Pathological Division during the fiscal year are set forth in the following table. It will be seen that at least 48 persons, besides a much larger number of animals, were bitten by the rabid animals. Prompt notice of diagnosis was given so that preventive treatment might be taken, consequently no deaths are known to have occurred among the bitten persons, although they and their families were nevertheless subjected to great anxiety and considerable expense.

Positive cases of rabies diagnosed by the Bureau of Animal Industry during the fiscal year 1909.

Date.	Record No.	Kind of animal.	Source.	Method of diagnosis.	Persons or animals bitten.
1908.					
July 2	1715	Cat	District of Columbia	Negri bodies	1 girl.
July 3	1719	Dog	do	do	2 dogs.
July 10	1730	do	do	do	1 dog.
July 11	1731	do	Norfolk, Va	do	1 child, several dogs.
July 13	1735	do	Maryland	do	None reported.
Do	1736	do	West Virginia	do	Do.
Do	1737	do	do	do	Do.
July 14	1741	do	District of Columbia	do	Do.
July 18	1749	do	do	do	Do.
July 22	1757	do	do	do	1 man.
July 24	1760	do	Virginia	do	None reported.
July 27	1766	do	District of Columbia	do	Do.
July 28	1767	do	do	do	1 man.
Aug. 3	1781	do	do	do	1 dog.
Aug. 5	1788	do	do	do	1 boy.
Aug. 10	1796	do	do	do	None reported.
Aug. 28	1827	do	do	do	Do.
Aug. 29	1829	Cat	do	do	1 boy.
Aug. 31	1830	Dog	Virginia	do	Several dogs.
Do	1831	do	District of Columbia	do	1 man.
Sept. 8	1842	do	do	do	None reported.
Do	1843	do	do	do	Several dogs.
Do	1844	do	do	do	2 boys, 1 dog.
Sept. 9	1848	Cat	do	do	1 man.
Sept. 10	1850	Dog	Virginia	do	1 child.
Sept. 14	1855	do	District of Columbia	do	3 adults.
Sept. 16	1859	do	do	do	None reported.
Do	1861	do	do	do	Do.
Do	1862	do	do	do	Do.
Sept. 21	1868	Horse	do	do	Do.
Sept. 24	1872	Dog	do	do	Do.
Sept. 25	1876	Cow	Maryland	do	Do.
Sept. 30	1880	Dog	Virginia	do	Do.
Oct. 2	1884	do	do	Inoculation of rabbits	Do.
Oct. 5	1888	do	District of Columbia	Negri bodies	3 adults exposed.
Oct. 12	1897	do	do	do	None reported.
Oct. 19	1908	do	Maryland	do	Do.
Oct. 20	1910	do	District of Columbia	do	Do.
Do	1911	do	do	do	Do.
Do	1913	do	Virginia	do	Do.
Oct. 21	1915	do	District of Columbia	do	Do.
Oct. 22	1918	do	do	do	Do.
Oct. 23	1919	do	do	do	Do.
Do	1923	do	do	do	Man and boy.
Oct. 27	1925	do	Virginia	do	None reported.
Oct. 29	1930	do	District of Columbia	do	1 horse.
Nov. 2	1934	do	do	do	None reported.
Do	1935	do	do	do	1 woman.
Nov. 4	1944	do	Virginia	do	2 cows, 2 dogs.
Nov. 6	1947	do	District of Columbia	do	1 boy.
Do	1950	do	do	do	Do.
Nov. 7	1952	do	do	do	None reported.
Nov. 12	1962	do	do	do	1 boy.
Nov. 20	1972	do	do	do	1 dog.
Nov. 23	1980	do	do	do	2 boys.
Nov. 27	1984	do	do	do	None reported.
Dec. 3	1988	do	do	do	Do.
Do	1989	do	do	Inoculation of rabbits	1 boy.
Dec. 4	1992	do	do	Negri bodies	None reported.
Dec. 8	1995	do	Virginia	do	Do.
Dec. 12	2001	do	do	do	3 persons exposed.
Dec. 14	2003	do	do	do	1 boy, 1 dog.
Dec. 19	2009	Cow	West Virginia	do	None reported.
Dec. 22	2014	Dog	Virginia	do	Do.
Dec. 24	2015	do	District of Columbia	do	3 dogs.
Dec. 28	2019	do	Virginia	do	2 persons.
1909.					
Jan. 2-9	2023	do	District of Columbia	do	1 girl.
Jan. 11	2032	do	Virginia	do	None reported.
Jan. 20	2050	do	do	do	Do.
Jan. 28	2059	do	District of Columbia	do	Do.
Feb. 5	2068	do	do	do	1 dog.
Do	2069	Cow	do	do	None reported.
Mar. 17	3030	Dog	Virginia	Inoculation of rabbits	Do.
Mar. 20	3035	do	West Virginia	Negri bodies	Do.
Mar. 22	3036	do	Virginia	do	4 dogs.
Apr. 5	3058	do	District of Columbia	do	3 children.
Do	3059	Cat	do	do	2 children.

Positive cases of rabies diagnosed by the Bureau of Animal Industry during the fiscal year 1909—Continued.

Date.	Record No.	Kind of animal.	Source.	Method of diagnosis.	Persons or animals bitten.
1909.					
Apr. 5	3061	Horse	West Virginia	Negri bodies	None reported.
Apr. 18	3082	Dog	South Carolina	do	4 people.
Apr. 21	3086	do	District of Columbia	do	1 man.
Apr. 26	3096	do	do	do	None reported.
Do	3098	do	do	do	1 man.
Do	3099	do	do	do	None reported.
Apr. 29	3103	do	do	do	1 child.
May 17	3124	do	do	do	Hens.
Do	3125	do	do	do	2 adults exposed.
May 19	3129	do	Maryland	do	1 child.
Do	2130	do	West Virginia	do	1 man.
Do	3131	do	District of Columbia	do	None reported.
May 21	3133	do	do	do	1 boy.
May 24	3136	do	do	do	Do.
May 25	3142	do	Virginia	do	None reported.
June 6	3156	do	District of Columbia	do	Do.
June 12	3172	do	do	do	1 boy.
June 14	3177	do	do	do	None reported.
June 15	3178	do	do	do	1 child.
Do	3179	do	do	do	None reported.
June 16	3180	do	do	do	1 child.
Do	3181	do	do	do	None reported.
Do	3182	do	do	do	1 dog.
June 17	3183	do	do	do	None reported.
June 21	3190	do	do	do	1 man.
June 24	3195	do	do	do	1 boy.
June 28	3200	do	do	do	None reported.

TUBERCULOSIS INVESTIGATIONS.

An exhibition of tuberculous specimens and cultures was made by the Pathological Division at the International Congress on Tuberculosis held in Washington in September, 1908, and much time was necessarily devoted to the preparation of this display. At this congress a demonstration was made by a European physician who claimed to be able to tell by a certain procedure whether any case of tuberculosis in the human subject owed its origin to human or to bovine material. Two patients by his examination were pronounced affected with tuberculosis from a bovine source. Sputum was obtained from each of them and tubercle bacilli recovered therefrom and thoroughly examined. One of these cultures disclosed characters which in the preliminary tests appear to be typical of tubercle bacilli of the bovine type, while the other apparently belongs to the human type.

An interesting investigation has also been made of tuberculosis which simultaneously affected the swine and the poultry of an Oregon ranch, causing great losses among both kinds of stock. Experiments showed that transmission of tuberculosis from fowls to swine readily occurs, and it seems most probable that the infected swine on this ranch obtained their infectious material from the tuberculous fowls which were kept near them.

Examinations were also made of cultures from two tuberculous cattle which were received from the Bureau Experiment Station, to determine the character of the tubercle bacilli which were present in the affected tissues and which must therefore be looked upon as the causative agents. One of these cases presented numerous cavities or vomicæ where the oldest of the lesions had existed. The bacilli recovered here have conformed in our preliminary experiments to the human type of tubercle bacilli. The other case was congenital tuberculosis in a calf, and the organisms recovered in this instance were found to belong to the bovine type.

The tests of the duration of life of tubercle bacilli in cheese and butter under the usual market conditions, undertaken in cooperation with the Dairy Division and which were in progress at the beginning of the year, have been continued throughout the fiscal year and are still being extended, as are various investigations in the immunization of cattle against tuberculosis in cooperation with the Experiment Station of the Bureau.

ANTHRAX.

Veterinarians from the Pathological Division have been sent to the South during the past year to assist in checking the spread of anthrax among the animals on the sugar and cotton plantations.

Many owners appear indifferent as to the fate of their cattle and are not disposed to take suitable measures for protecting them from infection. They have greater confidence in the powers of the "hoodoo bag" than in the efficacy of anthrax vaccines, and on many of the places visited these bags were observed tied about the necks of the animals, and because of the alleged protection thus afforded the owners considered that any further steps in the matter were quite unnecessary.

Owners of animals in infected districts were advised—

1. To remove all healthy stock from infected pastures and vaccinate them; to supply them with pure water and feed; to sponge them over with some disinfectant solution, thus reducing the chances of infection from the bites of insects.
2. To clean out all infected stables, finally washing the walls and woodwork with lime wash to each gallon of which 5 ounces of carbolic acid or commercial formalin have been added.
3. That all dead animals be incinerated.
4. That in the future all animals upon these infected places should be vaccinated each spring.

EFFECTS OF SMELTER FUMES ON LIVE STOCK.

Reports of heavy losses to the live-stock industry in the Deer Lodge Valley of Montana, alleged to be caused by smelter fumes, led the Bureau to make an investigation in 1905–6, and during the past fiscal year the results have been prepared for publication.

In the operation of a smelter, fumes laden with highly dynamized mineral elements are generated which are distributed over the surrounding country to a greater or less extent and are finally deposited on the grasses, crops, and forests. The region traversed by smelter smoke shows a steadily growing diminution in the quantity and quality of crops and vegetation of all kinds. Analyses of grasses, hay, soil, and animal tissues by the Bureau of Chemistry of the Department of Agriculture and by other authorities have demonstrated the presence of toxic quantities of arsenic. Animals subsisting on blighted feed soon show unthriftiness, and large numbers of horses and cattle as well as other stock die, while those that continue to live manifest lowered vitality, depraved nutrition, derangement of breeding functions, and sterility. The clinical symptoms of animals thus affected coincide with those known to science as symptoms of arsenical poisoning. Post-mortem findings in animals that have died and in affected animals purposely killed, as well as microscopic examination of the tissues of such animals, establish the accuracy of this diagnosis. Feeding experiments with known quantities of arsenic and the experimental local application of arsenic resulted in the production of symptoms and lesions identical with those found in affected animals.

INFECTIOUS ANEMIA OF HORSES.

The important feature of the year's work on infectious anemia, or swamp fever, of horses is the apparently successful immunization of a horse against this disease.

The results of the experiments of the year may be summarized as follows:

1. The virus of infectious anemia as contained in the blood serum of infected horses can pass through the finest porcelain filter bougie, and the serum thus filtered can reproduce the disease when injected into healthy horses. Microscopic examination of hanging-drop and stained cover-glass preparations of filtered serum and also culture tests made with such serum have failed to reveal any organisms, thus indicating not only that the causative factor of the disease is ultramicroscopic, but also that it is difficult if not impossible to discover it by the ordinary methods of bacteriological examination.
2. An experiment now under way indicates that artificial immunity may be produced.
3. Examination of the blood and urine prove that the corpuscles of the former decrease and that albumen appears in the latter during the advanced stages of the disease.

For the ensuing year, besides continuing experiments with urine and feces and with the feeding of virulent material, which are already under way, efforts will be concentrated on the study of artificial immunity and the methods of clinical diagnosis.

MILK SICKNESS IN TENNESSEE.

The peculiar disease known as milk sickness, so common in the mountains of the eastern part of the United States in the pioneer days, has, with the advancement of civilization and the consequent clearing of timbered lands, almost entirely disappeared. However, many localities in the Kentucky and Tennessee mountains are still considered to be dangerous by the mountaineers, and if cattle get into these localities by accident these people will not partake of their flesh or dairy products.

The discovery of the causative organism of this disease by Jordan and Harris in an outbreak in the Pecos Valley, New Mexico, in 1907, gave new interest to the malady, and during the past year under the direction of the Pathological Division some experimental animals were placed in the affected country in the region of Smithville, Dekalb County, Tenn., in the hope of developing a case of milk sickness or trembles. Six animals, including one fresh cow and calf, one dry cow, and two yearlings, were used. They were placed in several heavily wooded mountainous regions about Smithville, which is considered one of the worst localities for the disease in Tennessee. The animals remained in these places for about four weeks. During this time the dry cow and the fresh one died with what the farmers considered well-marked cases of milk sickness. On post-mortem the cause of death in the fresh cow was found to be pneumonia. The necropsy on the dry cow was negative and all evidence pointed to her having died as a result of being entangled and thrown by the retaining rope with which it was necessary to restrain her, as the range was very large and unfenced. Cultures were made from the blood of this animal, a rabbit was inoculated with its blood, and a dog was fed exclusively on its meat for three days, but with negative results.

One human case was seen, but cultures made from the blood of the ear lobe remained sterile, and a dog drenched with vomitus from the patient showed no ill effects. Winslow and Orme, Tenn., were also visited, but no history of recent cases could be obtained. It would therefore seem that at the present day milk sickness is rare. Many animals reported by the farmers in these localities as dying of milk sickness in reality die from other causes. From a careful study of the history of the human case it appears that the disease may be contracted in other ways than from the ingestion of milk and dairy products.

SAND-BURN IN TEXAS.

Under the local term "sand-burn" there exists in Nueces, Starr, Hidalgo, Cameron, and Duval counties, Tex., a skin disease, principally of horses, which is very prevalent during the hot summer months, and an investigation of this disease was undertaken by the Pathological Division.

The disease occurs especially on hot, sunny days after a rain. Certain areas of land seem to be particularly dangerous, and stockmen fence such areas on their ranges to keep stock out. These areas are usually low-lying, with water collecting in them after a rain.

Horses are by far the most frequent animals affected, but mild cases occur in mules, and cattle may develop the disease. Its manifestations occur suddenly and consist of an extreme itching or burning sensation. The affected areas become tumefied, edematous, and a clear serum oozes through the skin. The horse makes frantic efforts to bite the affected parts and finally the skin becomes broken, leaving a raw ulcer, which the animal, unless restricted, continues to make larger by its constant biting at the locality to relieve the itching. The eyes sometimes show the effects of an attack. White horses are particularly susceptible, and dark-colored horses with white noses and feet are also frequently affected. The eruption after healing frequently leaves a scar, and in some cases there are very unsightly permanent blemishes. At the time of the investigation in November no acute cases were available, but several bad cases in the process of healing were found. From one of these, a gray horse showing a large lesion on the flank, cultures and smears were made, but no organism which could be considered as the etiological factor developed on them.

The species of plants in the inclosed areas in the Lasater range country were found not to differ from those on the open range.

The disease is very closely allied to trifoliosis, resulting from eating alsike, bastard, and Swedish clover, and thought to be due to a fungus growing on these plants. Should this disease prove to be identical with trifoliosis, however, there must be some other plant which harbors the fungus, as none of these three varieties of clover are grown in that part of Texas.

BLACKLEG INVESTIGATIONS.

The Pathological Division has continued the preparation and free distribution of blackleg vaccine. During the fiscal year ending June 30, 1909, about 1,150,000 doses were prepared in the laboratory and distributed among cattle raisers. With greatly improved facilities for the manufacture of vaccine the Bureau has been enabled to send out a much larger supply of vaccine of uniform quality and on shorter notice than heretofore.

The results of vaccinations for the fiscal year ending June 30, 1908, as reported to the Bureau by stock raisers who have used the vaccine, are as follows:

Report on the distribution and use of blackleg vaccine for year ending June 30, 1908.

States.	Number of reports.	Number of cattle vaccinated.	Deaths same season previous to vaccination.		Died after vaccination.					
			Number.	Per cent.	Within 48 hours.	From 2 to 7 days after.	Within one year.	Total number.	Per cent of deaths after vaccination.	Number of cases due to mistakes.
Arizona	87	3,673	153	4.16	....	7	30	37	1.00	....
Arkansas	11	447	11	2.46	....	....	2	2	.44	....
California	385	53,294	476	.89	6	17	149	172	.32	....
Colorado	427	57,764	655	1.11	12	53	244	309	.53	....
Idaho	24	2,588	73	2.82	....	1	1	2	.07	....
Illinois	50	1,303	57	4.37	....	2	3	5	.38	....
Indiana	2	42	3	7.14	....	2	....	2	4.76	....
Iowa	148	8.443	118	1.39	2	1	10	13	.15	....
Kansas	362	28,936	359	1.24	4	23	85	112	.38	....
Kentucky	15	346	5	1.44	....	2	....	2	.57	....
Maryland	1	12	1	8.33	....	....	1	1	8.33	....
Michigan	2	50	....	....	....	....	....	....	....	....
Minnesota	25	897	42	4.68	....	....	....	....	....	....
Mississippi	1	242	15	6.15	....	3	....	3	1.24	....
Missouri	279	12,347	189	1.53	4	2	33	39	.31	....
Montana	173	34,909	651	1.86	14	17	124	155	.44	....
Nebraska	1,106	96,129	1,492	1.55	30	92	220	342	.35	1
Nevada	5	1,873	25	1.33	....	....	....	....	....	....
New Hampshire	2	22	....	....	....	....	2	2	9.09	....
New Mexico	82	16,185	484	2.99	2	5	48	55	.33	....
New York	14	328	15	4.57	....	....	....	....	.603	....
North Carolina	49	2,486	65	2.61	....	2	13	15	.29	....
North Dakota	300	25.431	477	1.87	4	5	65	74	.43	....
Oklahoma	57	69.72	190	2.72	1	12	17	30	.08	....
Oregon	78	31,702	206	1.50	2	2	7	11	....	....
Pennsylvania	2	30	1	3.33	....	....	....	....	....	....
Porto Rico	3	1,844	....	....	....	....	2	2	.108	....
South Dakota	432	41,317	898	2.17	18	33	180	231	.55	....
Tennessee	47	1,914	89	4.65	2	....	10	12	.62	....
Texas	535	107,311	1,247	1.16	25	60	854	939	.87	4
Utah	40	6.415	307	4.78	7	4	38	49	.76	....
Vermont	3	25	1	4.00	....	....	....	....	....	....
Virginia	355	12,720	338	2.65	4	17	73	94	.73	....
Washington	22	1,964	486	2.47	1	....	25	26	1.32	....
West Virginia	143	4,689	100	2.11	2	3	15	20	.42	....
Wisconsin	9	222	3	1.35	....	....	....	....	....	....
Wyoming	354	59,048	702	1.18	17	30	186	233	.39	....
Total and average	5,630	605,920	9,934	1.639	157	395	2,437	2,989	.49	5

A comparison of this report with reports of previous years shows a material decrease in the losses from this disease before vaccination and also a decrease in the percentage of losses after vaccination. Deducting the number of animals dying within forty-eight hours after vaccination as a result of previous infection, the percentage of losses after vaccination is reduced to 0.46 per cent.

THE BIOCHEMIC DIVISION.

This division, of which Dr. M. Dorset is chief, has been engaged during the year chiefly in the laboratory inspection of meat products, investigations concerning hog cholera, and tests of stock dips, besides continuing the preparation and distribution of tuberculin and mallein.

LABORATORY MEAT INSPECTION.

The laboratory meat inspection as carried out during the past year has consisted in the examination of samples submitted to the laboratories by the inspectors in charge of stations. During the fiscal year more than 17,000 samples of meat food products and substances used as ingredients in these products have been examined in the laboratories. Of these samples approximately 16,000 were from establishments where inspection is maintained; the remainder, somewhat more than 1,000 samples, being secured from establishments which operate under certificates of exemption from inspection.

About 5 per cent of the samples from establishments having inspection were found to conflict in some way with the meat-inspection regulations, but the greatest number of these cases were due not to unwholesomeness, but to incorrect labeling, such as the use of cereal in sausages without this being suitably shown on the labels, or the contamination of lards with very small amounts of cotton-seed oil resulting from lack of facilities in the packing houses, which necessisitated the use of the same equipment for pure lards and for compounds made of cotton-seed oil and other fats. It is apparently very difficult to remove all traces of cotton-seed oil from the pipes and mixing machinery in lard refineries, and this difficulty accounts for a considerable proportion of the samples found below standard. In houses where inspection is maintained the use of prohibited preservatives seems to have been almost completely discontinued, and in the few instances where preservatives were found this occurred for the most part from inadvertence on the part of the packer and not through intentional violation of the regulations.

It should not be understood from the foregoing that 5 per cent of all meat food products which reach the market are in conflict with the regulations, for in a great many cases the products are held by the inspectors pending the results of the laboratory inspection. The great majority of products that are found to be misbranded, adulterated, or to contain prohibited preservatives or coloring matters, therefore, never reach the market, but are either destroyed for food purposes if unwholesome, or properly labeled if the case is one of misbranding. In general, the meat food products examined in the laboratories during the fiscal year from inspected houses have been found to be in excellent condition.

Of the samples from exempted establishments about 8 per cent were found to violate the regulations. The proportion of samples from these houses which contained prohibited preservatives was considerably larger than in the case of the samples taken from inspected establishments. The laboratory inspection resulted in the withdrawal of certificates of exemption from a number of establishments.

PACKING-HOUSE WATER SUPPLIES.

Whenever there has been reason to doubt the wholesomeness of water supplies used on meats, samples of the water have been taken and subjected to chemical and bacteriological examination, which has been supplemented by a sanitary survey of the surroundings. In all, 124 samples of water from a large number of establishments located in different parts of the country have been examined, and when the water has been found unwholesome its use has been stopped or the insanitary conditions remedied. The Bureau insists that water used for washing or preparing meats shall be as clean and wholesome as would be required for drinking purposes.

RESEARCH AND MISCELLANEOUS WORK.

The study of the changes which take place in meats during the process of curing has been continued and a large amount of data have been collected. The first portion of the work, dealing with the changes which occur in the curing salts and in the coloring matter of meats, has been completed and is reported in a paper by Mr. Ralph Hoagland in the Twenty-fifth Annual Report of the Bureau.

The study of the causes which lead to the souring of meats during curing has been continued on a large scale, and it is believed that at least one of the causes of this condition has been detected in the form of a bacterium which has been isolated from sour meats. Extensive practical experiments with this organism are under way, the object being to determine definitely its relation to the souring of meats and to devise means of combating it.

An extensive study has been made of the water content of the various kinds of sausage meats, including fresh, frozen, and cured meats taken from different parts of carcasses, all being meats actually employed in sausage making. It is intended to compare these results with a similar study of sausages prepared from such meats and with commercial brands of sausages as found on the market. It is hoped that as a result of this work it will be possible to decide upon the desirability of definite standards for the water content of sausages.

The investigation regarding the composition of commercial meat extracts have been carried on extensively during the past year, but owing to the great amount of time required for the preparation of typical samples under commercial conditions it has been impossible to complete the work. Some firms engaged in the manufacture of meat extracts have placed their factories at the disposal of the Department and have cooperated with us in attempting to reach a decision regarding standards for these substances.

In carrying out the laboratory meat inspection it has been found that certain methods of analysis were not entirely satisfactory when applied to the varying conditions in practice, and efforts have been made to improve these methods where possible. It has been found that potassium nitrate does not, as is generally supposed, interfere with the turmeric test for boric acid, but the nitrites on the other hand do interfere materially with this test. This interference can be counteracted by the use of urea. A method whereby the various colors permitted to be used in connection with the preparation of meats may be separated and identified has been worked out. The results of both of these investigations will be prepared for publication. The effects of various bacteria in the curing of meats has been studied, and considerable attention has also been given to methods for detecting adulteration in fats and oils.

BRANDING INK.

During the fiscal year 2,858 gallons of branding ink were furnished to the inspectors in charge of meat inspection. This ink, which was sufficient to do all of the branding required by the Department, cost, together with the necessary containers for shipment, approximately $1,750. An improvement in the form of brass brands, suggested by the Chief of the Bureau, has added greatly to the efficiency of the ink. Experiments are being carried out to improve the form of ink and to secure inks adapted for special purposes.

HOG CHOLERA.

During the past year no effort has been made by the Bureau to prepare anti-hog-cholera serum on a large scale, nor have any extensive practical experiments except those previously reported been carried out. In a few cases practical tests for demonstration purposes have been conducted in Nebraska, Texas, Missouri, Iowa, and Maryland, and the results secured were in entire agreement with those previously reported. The greater part of the work of the Bureau during the past year has been devoted to efforts to improve the present system of immunization and to a study of the biology of the filterable virus which is responsible for hog cholera. It has been found that the process of hyperimmunization, which is necessary in the production of the serum, and which was first carried out by injecting diseased blood subcutaneously into the immune hog, can be accomplished quite as well by intravenous injection, the particular advantage in the latter being that the highly potent protective serum is produced by using only half the quantity of diseased blood which would be required if subcutaneous injections were given. In the case of immunes treated intravenously the carcasses of the hogs killed for serum are in excellent condition and appear to be entirely suitable for food. As the cost of hogs is one of the chief items of expense in serum production, this intravenous injection of immunes is regarded as a very valuable improvement, tending to reduce the cost of the serum very materially.

One other fact has been established by the work during the past year—that carbolic acid in the presence of albuminous substances is not a satisfactory disinfectant for hog cholera, as the virus is frequently found alive after twenty-four hours' contact with a $3\frac{1}{3}$ per cent solution of carbolic acid, and the same was found to be true of bichlorid of mercury, the latter disinfectant failing to destroy the virus after one hour's exposure to a strength of bichlorid equivalent to 1 part in 1,000. It has been found, however, that the disinfectant described in the last edition of the United States Pharmacopœia under the name "liquor cresolis compositus" is very effective for destroying hog-cholera virus and may be depended upon even in the presence of albuminous substances if used in a 3 per cent solution.

It is gratifying to report also that scientific workers in Germany and in Hungary have confirmed the work of the Bureau of Animal Industry regarding the efficacy of hyperimmune serum for combating hog cholera, and this serum is now on sale in Germany.

In my last annual report it was stated that the attention of certain state authorities had been called to the serum developed by the Bureau as a preventive of hog cholera. Since that report was written representatives of the States of Alabama, Colorado, Kentucky, Pennsylvania, Louisiana, North Dakota, South Dakota, Tennessee, Virginia, Delaware, Montana, Mississippi, Illinois, Wyoming, and Oklahoma have visited the experimental farm of the Bureau near Ames, Iowa, and have had explained to them the methods used. These conferences have resulted in a number of these States taking up the manufacture of this serum, and recent information shows that at least 20 States have undertaken the preparation of the serum to a greater or less extent. Eleven States have each appropriated sums of money exceeding $1,500 per annum for starting the serum production for the benefit of hog raisers. Considerable serum has been prepared by state representatives, and in all 25,000 hogs have been treated with serum so prepared. The results of the inoculations have been in the main quite satisfactory. The work is being broadened in States which have already begun, and it is expected that a number of other States in which the hog-raising industry is of sufficient importance will begin serum production in the near future.

In looking over the work of the past year we find no reason for believing that the previously reported successful results in protecting hogs against hog cholera have been based upon error, but are rather more confident than ever that a properly prepared serum can be depended upon to afford such protection. It is furthermore believed that this serum should serve as the basis for an energetic campaign looking to the eradication of hog cholera, or at least the elimination of this disease as a serious menace to the hog-raising interests. Such a plan is presented in a paper in the Twenty-fifth Annual Report of the Bureau.

During the year a technical paper by Dr. C. N. McBryde entitled "Filtration Experiments with *Bacillus choleræ suis*" has been published as Bulletin 113 of the Bureau, and a paper entitled "Recent Work of the Bureau of Animal Industry Concerning the Cause and Prevention of Hog Cholera," by Dr. M. Dorset, has been published in the Yearbook of the Department for 1908.

ANIMAL DIPS AND DISINFECTANTS.

The routine analytical work on animal dips and disinfectants has consisted in the examination of samples of dips submitted by manufacturers with the object of having their use permitted in official dipping, the examination of samples of various dips forwarded by field inspectors, and the examination of samples of petroleum oils and various substances used in the field for experimental purposes. A number of samples of disinfectants were also examined. Some of these were products used by the Bureau in combating outbreaks of disease among animals, and a large proportion were samples of disinfectants submitted for test by the general supply committee for the Government departments. Of 66 dips submitted by manufacturers with the object of having their use permitted in official dipping, 35 were found to be unsuitable and their use was not allowed. The examination of samples of dips sent in by inspectors disclosed the fact that some manufacturers were not maintaining their dips at the standard required and agreed upon, and the use of such preparations in official dipping was stopped.

During the outbreak of foot-and-mouth disease the manufacture of a large quantity of a cresol disinfectant to be used in the work of eradicating that disease was supervised by a member of the laboratory force. In addition 200 gallons of coal-tar creosote and cresol dips, intended for experimental use in cooperation with the Zoological Division, were prepared in the laboratory and shipped.

The laboratory has also undertaken a thorough investigation of phenolic disinfectants in order to ascertain accurately the factors which influence the efficiency of such preparations, particularly under conditions of practical use. A very large amount of chemical and bacteriological work has been carried out in investigating this question.

Examinations of a number of samples of crude carbolic acid submitted by inspectors of the Bureau have shown that many of these samples were of poor grade and not equal to the claims made for them.

The effect of sodium chlorid on the bactericidal action of bichlorid of mercury has been given some attention, the preliminary results indicating that a saturated solution of sodium chlorid does not materially affect the action of solutions of the bichlorid of moderate strength.

A paper entitled "Some Common Disinfectants" was prepared by the chief of the Biochemic Division and issued as Farmers' Bulletin 345. This paper gives information concerning the nature of commonly used disinfectants and advice as to the best methods of employing them.

EXPERIMENTS WITH RAT VIRUSES.

During the past year a considerable amount of cooperative work with the Bureau of Biological Survey of the Department has been carried out in testing rat viruses. These are represented to be cultures of bacteria which, when fed to rats, produce a disease which not only kills the animal to which the culture is fed but spreads to others. Several of these viruses were tested, but none of the germs which they contained were found to be reliable agents for killing rats, and none of them produced in the infected rats a disease which was transmissible to others. One case was of particular interest, it being shown that a product on the market and advertised as a virus contained no pathogenic bacteria, but depended for its efficacy upon the presence of a poison.

TUBERCULIN AND MALLEIN.

The distribution to state, county, and city health officers of tuberculin for official use in the diagnosis of tuberculosis in cattle has been continued, and during the fiscal year 251,213 doses were prepared and sent out. Mallein to the amount of 55,564 doses, for the diagnosis of glanders in horses, was also prepared and distributed.

THE ZOOLOGICAL DIVISION.

The Zoological Division, under the direction of Dr. B. H. Ransom, is chiefly concerned in investigating animal diseases of parasitic origin and in collecting and determining animal parasites.

ROUNDWORMS IN SHEEP.

In experiments relative to the prevention of parasitic infection in lambs, it was found that infection with nodular worms was entirely avoided by keeping the lambs and ewes separate in adjacent pastures, with a bare earth pen between into which the lambs until weaned were frequently turned with the ewes for sucking, the animals being returned to their proper pastures after each suckling period. At the age of 12 months the weight of the lambs averaged 82 pounds, which was 12 pounds more than the average weight of other lambs at 13 months which had occupied the same pasture as their mothers. The former, when killed at the age of about 1 year, were found to be very slightly infested with stomach worms and hookworms and entirely free from infection with nodular worms as already stated, while of the latter some died at the age of 6 to 8 months heavily infested with stomach worms, and the survivors, when killed at the age of about 1 year, were all infested in a moderate degree with stomach worms, hookworms, and nodular worms.

In another experiment lambs and their mothers were kept together but changed at intervals to different pastures, and the lambs when weaned were placed finally in a pasture separate from the ewes. At the age of 1 year these lambs showed a slight infection with stomach worms, hookworms, and nodular worms. Their weight averaged 78 pounds, or 8 pounds more than that of the lambs mentioned above which were kept with their mothers in one pasture without change.

These experiments have shown that the degree of parasitic infection in lambs can be reduced by changing the flock at intervals to fresh pasture, and that the suckling-pen method gives almost perfect protection from infection with internal parasites.

Experiments in which tobacco was fed to lambs during a period of several months indicated that this remedy, which has been more or less highly recommended in live-stock journals during the last two or three years, is inefficient against stomach worms. At the close of the experiment there was no appreciable difference in the condition of lambs which were fed tobacco and of those which were not, stomach worms being fully as common in the former as in the latter.

GID IN SHEEP.

The investigations concerning this disease and the parasite which causes it have been continued. A remedy (repeated doses of male fern), which has been employed in Europe with reported success in a number of cases of somatic tæniasis in human subjects, has been tried in several cases of gid with no resulting benefit.

EXPERIMENTS WITH COAL-TAR DIPS FOR CATTLE MANGE.

In cooperation with the Biochemic Division of this Bureau and the South Dakota Agricultural Experiment Station, seven lots of cattle affected with scabies were dipped experimentally during an investigation to determine the percentage of the different constituents of coal-tar dips which should be present to render them effective in the treatment of this disease. On account of the slight infection at the time of dipping the favorable results obtained in the case of four of these lots of cattle are not considered trustworthy. These four lots were dipped in dips containing when diluted the following percentages of phenols and coal-tar oils: (1) Phenols, 0.1 per cent; coal-tar oils, 1.2 per cent; (2) phenols, 0.4 per cent; coal-tar oils, 1 per cent; (3) phenols, 0.2 per cent; coal-tar oils, 1 per cent; (4*a*) phenols, 0.5 per cent; coal-tar oils, none. These four lots of cattle remained free from mange for one year after dipping. The lice with which the animals were infested were not eradicated by the dipping. Three lots dipped in the following dips remained scabby after dipping: (4*b*) Phenols, 0.75 per cent; coal-tar oils, none; (5) phenols, 1 per cent; kerosene, 1.2 per cent; (6) phenols, 1 per cent; crude petroleum, 1.2 per cent. The lice with which the cattle were infested when dipped were not destroyed by dip 4*b*. The effect of dip 6 on the lice was not noted. The cattle dipped in dip 5 were free from lice when examined six months after dipping.

Three lots of scabby cattle were dipped near Merriman, Nebr., in dips of the following composition: (10) Phenols, 0.75 per cent; coal-tar oils, none; (11) phenols, 0.1 per cent; coal-tar oils, 1.2 per cent; (12) phenols, 0.2 per cent; coal-tar oils, 1 per cent. All of these dips failed to cure.

A proprietary coal-tar creosote dip tried experimentally on scabby cattle near Pine Ridge, S. Dak., injured the skin so seriously that the second dipping was omitted and the experiment terminated.

From the experiments with coal-tar dips it may be concluded that these dips, when diluted to a degree which has been found effective in the case of sheep scab, are inefficient in the treatment of cattle mange. Whether they can be used sufficiently strong to cure cattle mange without unduly injuring the animals remains to be determined.

INVESTIGATIONS RELATIVE TO TICK ERADICATION.

It was found in experiments with arsenical dips that when tick-infested cattle were dipped once in a solution containing an equivalent of about 0.2 per cent arsenic trioxid by weight in the form of sodium metarsenite, and about 0.2 per cent pine tar by volume, less than 5 per cent of the female ticks survived to deposit eggs. It was also determined that only about 1 per cent of the eggs deposited by ticks surviving the dipping hatched, as compared with a fertility of about 50 per cent among eggs of ticks from undipped cattle, kept under similar conditions. In other words, the number of the next generation resulting from ticks present on cattle at the time of dipping in the arsenical solution in question was less than one one-thousandth of the number which would have resulted if the cattle had not been dipped, other conditions being equal.

The investigations relative to tick eradication conducted in cooperation with the veterinary department of the Alabama Polytechnic Institute at Auburn, Ala., have been continued.

INVESTIGATIONS CONCERNING PARASITIC PROTOZOA.

Considerable time has been spent in an attempt to clear up that portion of the life history of the Texas-fever organism which occurs in the tick, but as yet little progress has been made in the solution of this difficult problem.

The discovery has been made that apparently healthy American cattle commonly harbor a trypanosome in their blood. Direct microscopical examination of the blood does not reveal the presence of this parasite. In cultures made from bovine blood, however, it appears in large numbers after three to four days' incubation at a temperature of 20° to 25° C. This trypanosome appears to be nonpathogenic to cattle. Attempts to transmit it to other animals have failed. A similar trypanosome found in cultures of bovine blood by a Japanese investigator was considered by him to represent a stage in the life history of a species of *Piroplasma* which occurs in cattle in Japan. Our investigations have shown with certainty that the trypanosome found in the blood of American cattle has no genetic connection with the parasite of Texas fever.

OTHER WORK.

Parts 21, 22, and 23 of the Index-Catalogue of Medical and Veterinary Zoology have been issued during the year.

Three hundred and sixteen new entries have been made in the catalogue of the collection of parasites during the past year. The total number of specimens now in the collection is 5,640.

Eighty-one autopsies on various animals, wild and domesticated, were performed during the year with reference to the presence or absence of parasitic infestation.

THE EXPERIMENT STATION.

The Bureau Experiment Station is located at Bethesda, Md., and is in charge of Dr. E. C. Schroeder. The general character of the work consists of independent original investigations, investigations in cooperation with other divisions of the Bureau, and the provision of facilities for other divisions of the Bureau to make investigations of a kind that require farm and field conditions not obtainable within the city's limits.

TUBERCULOSIS INVESTIGATIONS.

The most important investigations made during the past year concern the disease known as tuberculosis. An experiment to determine the value of the method of immunizing cattle against tuberculosis, developed by Pearson in the United States and by Von Behring in Europe, is nearing completion. In a general way our work has shown that this method of immunization actually protects cattle fairly well against tuberculosis, but as it requires the introduction into their tissues of living tubercle bacilli of the morphologic type more commonly associated with the tuberculous lesions of persons, it is questionable whether its extensive practice should be advocated. This is especially true in the light of the work reported by various investigators relative to the elimination of tubercle bacilli from the bodies of cattle after injection in various ways. It is claimed by some of these investigators, for example, that tubercle bacilli injected under the skin or into the circulation of a cow are to some extent eliminated through the udder with milk. If this claim is true, no system to protect cattle against tuberculosis that requires the introduction of living tubercle bacilli into their bodies can be characterized as anything better than a means to protect live stock at danger to public health.

Another method of immunization against tuberculosis is also being tested. This is known, named after its inventor, as the Heymans method. It is simply the introduction of virulent tubercle bacilli, enveloped in a sack of vegetable fiber, which in turn is inclosed in a gelatin capsule, under the skin of the animal. It is too early to say much about this method, though some of our observations tend to discourage great expectations either as to safety or efficiency. The Heymans capsules are claimed by their inventor to confine tubercle bacilli so that they can not actually pass into the tissues of a treated animal. Anthrax bacilli, which are much larger than tubercle germs, introduced into Heymans capsules under the skin of sheep, have been found to pass rapidly through the walls of the capsules and cause fatal disease accompanied by the usual presence of innumerable anthrax bacilli in the blood.

Considerable attention was given to hog tuberculosis, with special reference to the sources from which the bacilli that cause it are more commonly derived. More work is necessary before a complete report can be written on this subject, but it is interesting to know that among three lots of hogs exposed respectively to milk from tuberculous cows, feces from tuberculous cows, and to hogs affected with tuberculosis, those exposed to feces contracted tuberculosis much more frequently than the other lots. This bears out our former conclusion that the feces of tuberculous cows are probably the commonest cause for the propagation of tuberculosis among hogs. As far as our work has gone the exposure of hogs to the feces of tuberculous cows has infected them with fully ten times the certainty that followed their exposure to tuberculous hogs or from feeding them the whole milk of tuberculous cows. Examinations made by the Bureau have shown, however, that tubercle bacilli are present in a very large percentage of the samples of centrifuge slime from public creameries. In view of the danger from these two sources hog breeders are urged to protect their hogs from contact with the feces of cows that have not been proven by the tuberculin test to be free from tuberculosis, and to boil the skim milk which is obtained from public creameries and used as hog feed. It is gratifying that the work of the Experiment Station demonstrating that apparently healthy but tuberculous cattle intermittently expel tubercle bacilli with their feces now has the confirmation of the British Royal Commission on Human and Animal Tuberculosis (see Third Interim Report of the Commission, issued at London early in 1909).

During the year an article that pronounced tuberculosis in all its forms to be a bacteriemia, and that received unusually wide attention, was published by an American investigator. As this view, which stamps the disease as being constantly associated with the presence of numerous tubercle bacilli in the blood, had an important bearing on the meat-inspection regulations of the Bureau with regard to tuberculosis, an investigation was immediately undertaken to prove definitely to what extent the blood of tuberculous subjects actually contains tubercle bacilli. Numerous microscopic examinations and inoculation tests were made with the blood of tuberculous cattle. Some of the cattle were long-standing cases of generalized tuberculosis and were expelling numerous tubercle bacilli in their feces. In no instance were tubercle bacilli found in the blood, and hence we are justified in concluding that, in animals at least, tuberculosis is not a disease that can be characterized as a bacteriemia in any sense of the word, though in some forms of tuberculosis the bacilli may in rare instances be present in the blood, probably for short periods of time.

A number of tuberculous cattle were kept at the Station to test the potency of the tuberculin sold by different manufacturers in this country. The tuberculins tested during the year were all found to be satisfactory.

It is of some importance to record in connection with the various tuberculous cattle kept under close observation at the Station that the frequency with which udder tuberculosis developed among them is surprising. The development of the disease in the udder in one or two instances was so insidious that the milk of the cows was found to be infected with tubercle bacilli by guinea-pig injections long before the slightest lesion of local disease could be detected by a physical examination. In one instance it was determined, after weeks of inoculation tests, that infected milk was produced by one quarter of the udder of a seemingly healthy but actually tuberculous cow, while the remaining three quarters produced noninfected milk.

One case of udder tuberculosis observed in a cow is particularly instructive. The disease extended to and developed in the udder with great suddenness and violence. In the course of a few days an apparently healthy udder, including the associated lymph glands, became affected with a diffuse tuberculosis that wholly destroyed its normal function. Half of the udder became so swollen that its size was at least three times as great as normal. On post-mortem examination no real typical lesions of tuberculosis could be found, but the entire affected region was saturated with unusually virulent tubercle germs. This case shows how great the danger may be from a tuberculous cow, even when it can not be proven that her milk contains tubercle bacilli, and that tuberculosis of the udder may develop without warning at any time in a tuberculous cow.

An investigation has been planned to determine whether the use of pasteurized milk containing dead tubercle bacilli is injurious to the health of those who drink it, either because the dead bacilli may cause pathological conditions or because swallowing dead tubercle bacilli may lower the normal resistance of the body to living tubercle bacilli, a few of which, under existing conditions, are almost certain to find their way, sooner or later, into the body.

An investigation is also in progress relative to the percentage of healthy calves that can be raised from a herd of tuberculous cattle. The object of this investigation is to obtain additional and much-needed data regarding the economic eradication of tuberculosis from among cattle. This investigation is also of special interest because it may throw some light on the possible development of tuberculosis during later stages of life from tubercle bacilli that were swallowed during the true milk-drinking period.

RABIES.

During the year a number of dogs that had been bitten by rabid dogs were kept in quarantine, and one horse that had been bitten by a rabid dog was treated under the direction of, and with material received from, the Hygienic Laboratory of the United States Public Health and Marine-Hospital Service. The horse was discharged in perfect health ninety days after the treatment was completed, and as nothing has since been heard from the case the treatment was undoubtedly effective in preventing the development of rabies.

If the frequency with which the attention of the Station has been called to rabid dogs has any value as a guide to the prevalence of the disease, we may conclude that it is still markedly in evidence in and about the District of Columbia.

OTHER DISEASES.

Some time and attention were given to special investigations concerning foot-and-mouth disease of cattle in cooperation with the Pathological Division, but as this subject has been treated at length in a Bureau publication (Circular 147), it need only be referred to here.

The subjects of hog diseases, Texas fever, cattle ticks, cattle-tick dips, anthrax, blackleg, glanders, swamp fever, cattle mange, infectious abortion, the internal and external parasites of sheep, the marking and branding of sheep, etc., have also received more or less attention at the Experiment Station.

OTHER WORK.

The breeding investigations conducted in cooperation with the Animal Husbandry Office have given some interesting results. This work is presented in the part of this report which relates to the Animal Husbandry Office.

As in former years, large numbers of small experiment animals and a large quantity of green forage were raised at the Station. Several needed buildings of small size were constructed, and the second and completing story was added to the new laboratory.

THE ANIMAL HUSBANDRY OFFICE.

Mr. George M. Rommel, Animal Husbandman of the Bureau, directs the work of this office, which relates to the breeding and feeding of live stock and poultry, the supervision of pedigree record associations, etc.

HORSE BREEDING.

COLORADO WORK.

The stallion to follow Carmon in the cooperative horse-breeding experiments with the Colorado Experiment Station at Fort Collins has not yet been purchased, although a number of horses have been inspected, which have not proved sufficiently desirable to be used. It is hoped that a suitable stallion will be found in time for the 1910 season.

The purchasing board, acting as a board of survey, in August, 1908, condemned 19 animals in the stud, three of which were mares purchased in 1905, which have proved to be unsatisfactory breeders. With the exception of one filly owned by the experiment station, which was injured just before the sale, the condemned animals were sold or turned over to the Colorado Agricultural College for work purposes. The filly mentioned will be sold in the near future. Annual inspections for similar purposes are arranged for.

The high mortality of foals throughout the State was felt at Fort Collins, and serious losses occurred for no apparent reason, unless it was adverse climatic conditions.

VERMONT WORK.

The work at the Morgan Horse Farm, near Middlebury, Vt., in cooperation with the Vermont Experiment Station, is progressing satisfactorily, and the farm has been much more fortunate in the foals of 1909 than was the case in the Colorado work. Ten foals were dropped, out of twelve mares bred. The new sheds are proving satisfactory, but the accommodations will soon be crowded, and additional stable room will be needed. It is possible that the present facilities will suffice during the coming winter, but provision should be made in the near future for a total of 25 brood mares in addition to stallions and young stock.

The most important improvement during the year has been the installation of a first-class water system. It is the well-known pneumatic system, with a 15,000-gallon underground tank. The pump is run by an electric motor, which is equipped with an automatic starting and stopping device. Very little attention is needed, and the pressure in the mains is practically constant. The system not only makes it possible to supply water to any part of the farm, but gives adequate fire protection as well.

IOWA WORK.

The Shire and Clydesdale mares used in the experiments in cooperation with the Iowa Experiment Station are proving to have excellent endurance, especially in hot weather. They are noticeably fast walkers. Only one mare foaled during the fiscal year.

The station has added to the stud the Shire mares Wrydelands Starlight (37804), Wrydelands May (43904), and Stow Silver Streak (52348). They have had excellent show records in both England and America. All these mares have been reduced in flesh and have been bred to the Clydesdale stallion Kuroki (13214).

CLASSIFICATION FOR AMERICAN CARRIAGE HORSES.

The classification for American carriage horses which was offered at twelve state fairs in 1908 at the Department's suggestion, resulted in very interesting and instructive exhibits. The animals shown were not all one could wish in every case, but they were all one could expect. That the fair managers believe that the classification is a useful one is shown by the fact that, with very few exceptions, the classification is being offered by the same fairs for 1909, although no assistance is rendered by the Department except furnishing judges when requested. Besides the fairs which offered the classification last year, the Missouri State Fair offers the complete classification for 1909, whereas only a partial one was offered in 1908, and the classification is offered by three additional fairs, including the live-stock show of the Alaska-Yukon-Pacific Exposition. Fourteen fairs of state or national importance have provided the classification for 1909. No change has been made in requirements and the classification stands as published in the revised edition of Bureau of Animal Industry Circular 113. Representatives of the Bureau attended each state fair offering the classification in 1908, and it is planned to continue this custom.

SHEEP BREEDING.

During the past year the range sheep-breeding work in cooperation with the Wyoming Experiment Station has been fairly satisfactory. During the lambing season in the spring some lambs were lost on account of the severe storms which continued for several days at a time, but the number lost was much less than it would have been if the new lambing sheds had not been available. The use of these sheds has proved to be a very good investment.

The flock was sheared earlier than in 1908, and owing to the heavy rains during the spring the wool was much cleaner and the percentage of shrinkage in scouring will probably be considerably less. The number of sheep shorn was 307, of which 291 were ewes, 7 mature rams, and 9 yearling rams.

The total number of lambs dropped in 1909 and living on July 15 was 137; ewe lambs, 62; ram lambs, 73; sex not reported, 2. It is proposed to reserve three of the yearling rams for breeding purposes and to sell the remainder.

CATTLE BREEDING.

MILKING SHORTHORNS.

The experiment in breeding milking Shorthorn cattle, carried on in cooperation with the Minnesota Experiment Station and individual breeders, has been continued, and the circuit now includes five herds, each of which is visited by the circuit superintendent for two days each month, when weights of milk and samples for butter-fat determinations are taken from four milkings. The cooperating breeders have been fitted out with milk sheets and spring balances, and are keeping records of the daily milk production of each cow. From these milk sheets, combined with the monthly check weights and butter-fat tests, annual semiofficial records will be made. A statement of milk and butter-fat production, feed consumed, and breeding record for each animal is sent to the owner by the station at the end of each month.

Thus far the results indicate an annual yield of 3,000 to 6,000 pounds of milk and 125 to 250 pounds of butter fat in three herds owned by private individuals, complete records not being available for the fourth. In the station herd, where the animals are fed and handled more carefully for dairy production, the yearly records are now complete, or nearly so, and show yields of from 4,000 to 8,000 pounds of milk and from 125 to 325 pounds of butter fat per annum.

BREEDING HOLSTEIN CATTLE.

A cooperative Holstein cattle-breeding experiment, similar to the work with milking Shorthorns in Minnesota, was begun during the year in North Dakota, in cooperation with the State Experiment Station. A circuit of 18 members has been formed within a radius of 12 miles of New Salem. There are 18 herd bulls and 47 cows in the circuit.

GENERAL ANIMAL-BREEDING INVESTIGATIONS.

The breeding experiments which are in progress at the Bureau Experiment Station at Bethesda, Md., are giving satisfactory results. During the past year six zebra-ass hybrids have been foaled. The first three of these were very weak and died shortly after they were born. The remaining three are vigorous, promising individuals.

Numerous attempts have been made at artificial impregnation to produce zebra-horse hybrids, but so far without success. We have also failed in getting direct service between a zebra and a mare.

Breeds of sheep having decidedly different characters have been crossed, and observations are being made of the characters inherited from either parent.

Breeding experiments in which small mammals (guinea pigs and rats) are used are in progress, and interesting data are being collected. This is true particularly of the inbreeding, in which nearly 4,000 animals have been under observation and all important data recorded. At present there are about 1,500 breeders in the experiment. The closest form of inbreeding is being practiced with these animals. Individuals of the same litter have been mated together, many of them for seven generations. Others have been bred to their parents for four generations.

Several small animals are being used in experiments in which the breeders are selected for some particular character, as the fixing of coat color and pattern or the fixing of some slight variation from the normal type. Results thus far obtained seem to indicate that Mendel's law applies to the breeding of animals so far as the inheritance of coat color and color pattern are concerned.

POULTRY INVESTIGATIONS.

MAINE WORK.

The cooperative work in breeding for increased egg production at the Maine Experiment Station has been continued, but the basis of selection has been changed, and individuals of both sexes are now chosen by reason of their centgener power, or ability to produce offspring which are uniformly good producers. As previously planned, the experiment of trying the introduction of new blood in the flock was tried, but without any significant result in increased egg production.

In accordance with the plan of testing various other breeds besides the Barred Plymouth Rock, a trap-nest test of Cornish Indian Game pullets from some of the best strains in America is being carried out, and a large number of promising hybrid chickens from the two breeds have been raised.

Part I of a biometrical study of egg production in the domestic fowl, based on the trap-nest records of the Barred Plymouth Rock stock of the station for the last ten years, has been completed and published as Bulletin 110 of this Bureau, entitled "Variation in Annual Egg Production." Part II, dealing with the seasonal distribution of egg production through the year, is practically complete, and will soon be ready for publication. Farmers' Bulletin 357, describing the methods of poultry management employed at the Maine Experiment Station, was issued during the fiscal year.

Future work will be continued along the same lines, namely, study of the accumulated records and breeding for increased egg production, with the associated problems which may arise, and the testing of other breeds and of the hybrids secured.

INDEPENDENT INVESTIGATIONS

During the year the comparison of the wet and moist mash and the hopper systems of feeding laying hens, which has been under way for over two years, has been continued at the Bureau Experiment Station at Bethesda, Md., and this work is nearing completion.

A form of coccidiosis appeared in the spring in both the mature stock and the young stock raised. As a result, a high mortality of the chicks was occasioned. While the mortality was checked, those surviving have been so badly stunted that they are not considered worth saving for breeding purposes.

The trap-nest records of all laying hens have been carefully kept, but it has been impossible to begin the proposed inbreeding work because of lack of suitable facilities. Pens of such a size that a single cock bird could be used in each would be necessary for this purpose.

The preliminary field study of the conditions surrounding the production and marketing of eggs has been completed and a report has been issued as Circular 140 of this Bureau.

The cold-storage evaporimeter devised by the assistant in charge of the egg-market investigations and mentioned in last year's report has been patented by the Department. A circular (No. 149) of this Bureau describing the device and the manner of using it has been published.

A number of desirable projects for future poultry work present themselves. An effort could well be made to encourage the keeping of better poultry in the Southern States, where natural conditions are favorable, by the introduction and sale in certain localities of good utility cock birds of a general-purpose breed. By cooperation with a number of large poultry farms valuable data could be obtained on the cost and efficiency of various large-scale operations. The ostrich industry is rapidly growing in this country and is demanding work in its behalf. Investigations with the view of increasing fertility of eggs and decreasing loss of quality of feathers due to barring would be timely.

ANIMAL-NUTRITION INVESTIGATIONS.

The investigations in animal nutrition in cooperation with the Institute of Animal Nutrition of the Pennsylvania State College have been continued. The work of the past year has been substantially a continuation of that described in the report for the fiscal year 1908.

A bulletin is in course of preparation reporting the results of three years' work on the influence of age and type of cattle upon the utilization of their feed, and it is proposed to make further studies of the energy values of typical feeding stuffs with a view to securing more accurate data as to their real nutritive value. A general discussion of the energy values of feeding stuffs has been prepared and published as Farmers' Bulletin 346. The data of that bulletin, however, are not in all respects satisfactory, either as to the factors used for the energy values or as to the average composition of American feeding stuffs. It is hoped that the investigations now in progress will add to our knowledge upon the former point. Work on the latter will be commenced by an assistant to the Animal Husbandman, who will undertake a thorough compilation of recent American analyses and digestion experiments, which should lead to the construction of more satisfactory tables than now exist.

SOUTHERN BEEF PRODUCTION.

The work in studying the production of beef cattle in the South has been carried on during the past year along practically the same lines as outlined in the previous report. Satisfactory results are being obtained and the work will be enlarged during the year. Among the other projects which will be taken up will be the study of the economy of silage as a winter feed for beef cattle. A report of the work of the past three years is being prepared for publication.

SUPERVISION OF PEDIGREE RECORD ASSOCIATIONS.

The time and assistance available during the past year for the work of supervising pedigree record associations under the tariff law have been very largely occupied in a thorough study of the records of one of the most prominent draft-horse associations in the country. This investigation is still pending. It has become evident that close supervision by this Department of the business of recording animal pedigrees is of vital importance to the live-stock industry of the country. Clean studbooks can not be expected when they are managed by men whose interests may be served by loose or questionable methods. Canada has taken a long step forward in the solution of this problem by having all pedigree recording of useful domestic animals done by the Dominion government. It may be to the interest of the United States to follow Canada's example in the near future. There is a growing sentiment in favor of such a step.

There were on the certified list at the close of the fiscal year 133 books of record, of which 66 were American and 67 foreign.

THE DAIRY DIVISION.

The work of the Dairy Division, under the direction of Mr. B. H. Rawl, chief, is organized in five branches, as follows: (1) Dairy farming investigations, (2) dairy products investigations, (3) dairy manufacturing investigations, (4) market milk investigations, and (5) renovated butter inspection. A large part of the work of the division is educational in character and is being carried out in cooperation with state and local authorities and through organizations such as city boards of health, state dairy associations, and the like. These institutions are expected to reach the individual farmers and dairymen in their respective regions, and thus the greatest good to the greatest number is accomplished. During the past fiscal year 264 dairy meetings and farmers' institutes, in 37 States, were attended by employees of the Dairy Division, and assistance was given in conducting 4 dairy schools.

DAIRY FARMING INVESTIGATIONS.

SOUTHERN DAIRYING.

The work for the development and improvement of the dairy industry in the South has been continued along the same lines as in the previous fiscal year, namely, herd improvement and economical feeding; building of barns, silos, dairy houses, etc.; creating an interest in such organizations as dairy associations; improvement of city milk supplies; etc. Ten men have been regularly employed in this work, which is in progress in the States of Alabama, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, and Texas.

Dairy farmers are advised to keep records of their herds so as to show the cost of feed, the yield of each cow, etc. During the year records of 73 herds, containing 1,642 cows, were kept by dairymen under the supervision of the Dairy Division. The value of keeping records was demonstrated by the fact that 138 cows were removed from the herds because their records showed them to be unprofitable. Some dairymen with whom the division has done work in the past have this year been carrying on systematic records by themselves, and others have begun to make records because of the good results from this practice which they have seen on the farms of their neighbors. The use of purebred bulls comes as an immediate result of keeping records.

Sixty-six silos have been built in the Southern States during the past year as a result of the work of this division. Seventeen were concrete, 3 brick, 7 modified Wisconsin, and 39 stave. Including some built in previous years, 13 concrete silos cost on an average

$2.17 per ton capacity; 46 stave silos cost on an average $1.50 per ton capacity, and 9 modified Wisconsin silos cost on an average $1.36 per ton capacity. On account of the permanency of concrete construction, that type of silo is built wherever the conditions will permit. As a rule, in the Southern States good lumber is available and is cheap; hence it is often considered best for the beginner to build a silo of wood. Applications have been received in the last few months for assistance with 103 silos. One of the most gratifying features of the work in the South is that wherever a barn or silo is built one year there are sure to be others built in that locality the succeeding year.

There were 25 dairy barns built during the past year, and 10 old barns were remodeled. In addition 31 applications were on file for assistance in building. There were also 20 dairy houses built during the year and 5 remodeled, while 6 applications for assistance in building were still unacted on.

Assistance has been given in improving the milk supplies of 20 cities. In 18 of these the score-card system of inspection has been used. This work has been the means not only of much improvement in the sanitary conditions of the farms and premises, but of increasing profit to many of the producers.

Some assistance has been given in organizing a few creameries in Virginia and one in Texas. On the other hand, the building of creameries is discouraged where it appears that local conditions are such as to make their success impossible.

A new feature of the work in the South was the holding of two dairy schools (one-week session), one at Newton and the other at Dana, N. C. At Newton there was an average daily attendance of 50 persons, at Dana of 30 persons. These schools were conducted on the following plan: A small building or a portion of a building was secured, in which was placed enough hand machinery to conduct the entire work of a farm dairy. Separating, churning, and testing were performed during the forenoon of each day, beginning at 8 o'clock. The afternoons and evenings were devoted to lectures, and these were so planned as to cover the most important questions that the beginner in dairying in these localities needs to understand. These schools have not been conducted for a sufficient length of time to warrant definite conclusions as to their merits, but from the results so far obtained they seem to offer an effective means for teaching dairying, particularly in communities where it is undeveloped and where farm butter making must to a large extent be practiced. Plans are being made to conduct fifteen more such schools during the coming year. As an outcome of these two schools a farm dairy butter contest was organized. Each competitor sends to the agricultural college 1 pound of butter on a certain day in each month for twelve consecutive months. This butter is scored by the dairyman at the college, and letters of criticism are sent to the maker of each sample. Prizes are provided by the state department of agriculture.

Assistance was given by the field men at nine fairs. At each of them a butter contest was held, and at seven of them model dairies were operated. A small exhibit was made of plans of farm dairy buildings, and publications on various dairy subjects were distributed.

All the work in the Southern States has been done with the hearty cooperation of the state institutions, and these institutions are showing their approval of the work by increasing assistance. In North Carolina the state department of agriculture has provided $2,850 to supplement the work for the present fiscal year. The State of Georgia has provided $600 for the work, Mississippi has provided about $800 or $1,000, South Carolina has provided $600, and Tennessee is expected to provide funds for the work in the near future.

COW-TEST ASSOCIATION WORK.

One employee has been engaged during the year in giving assistance to state officials in organizing and conducting cow-test associations. These are organized and operated along the following general plan: Approximately 26 members constitute an association. A tester is employed who makes a monthly visit to each farm, arriving one afternoon and remaining until the following afternoon. While at the farm he makes a record for each animal of the milk produced and the feed consumed, and on this basis he balances the account of each animal for the period of which the day of his visit is the center. The tester is paid by the association $1 a year for each cow owned by the members. He also receives his board and transportation from one farm to another free of cost. At the end of the year the tester determines what each animal has made. In addition to this very valuable information, the monthly visits to the farm enable him to give much assistance relative to various phases of the dairy work in progress.

Monthly meetings are held by the association, at which subjects of interest to the members are discussed. The association has, therefore, features of education and cooperation that extend considerably beyond the scope of dairying. There are now 27 of these associations organized, with 741 members, owning 11,686 cows, in nine States, as follows: Wisconsin, 10; Michigan, 5; Maine and Vermont, 3 each; Iowa, 2; California, Pennsylvania, Ohio, and New Hampshire, 1 each. All but five of these associations were organized during the past fiscal year.

No assistance is given in this work unless some state or local institution will take the immediate control of it. While the plan of operation makes the association self-sustaining, a certain amount of supervision by some state official will always be necessary. The institution taking active charge of the work agrees to furnish this necessary supervision. It is very important that the first associations organized in a State be closely watched so as to make sure of their success; but after two or three are operated for a year or two, others can be handled much more easily. By that time other farmers understand something of the work and the officials in charge also have become familiar with handling the various difficulties that arise. It is the object of the Dairy Division to provide when possible the assistance necessary to enable the official in charge to give the proper supervision.

Much interest is being shown in the movement. The State of Wisconsin is employing two men for the work. Vermont has provided the sum of $5,000, a large part of which is to be used for test association work, and Iowa has appropriated $10,000, a large part of which will be similarly used. Ohio has also provided some funds that can be used in the same manner.

The fact that the average dairy cow of this country is producing only about half of what is within easy reach of the ordinary farmer of average intelligence indicates the enormous opportunity for systematic record work. We consider, therefore, that this is a very important work, and it is planned now to increase it as much as the funds available for the ensuing year will permit. It is not the policy to organize too many of these associations, but rather to organize a smaller number in the best localities so as to be sure that they will succeed. The state institutions are asked to make an annual report, showing the results produced by all the associations in each State.

SILO AND VENTILATION EXPERIMENTS.

Two cement-and-metal silos have been built and used, and have proved entirely satisfactory. A report showing the details of the experiment will soon be ready for publication.

Two experimental silos that will make it possible to determine the exact pressure of silage have been built, and special dynamometers have been designed for use in determining the pressure. These experiments will probably have to be continued another year.

An experiment in stable ventilation has been in progress two years at the barn of Mr. H. McK. Twombley, Madison, N. J. The object is, first, to determine the effectiveness of the various systems of ventilation now in use, and, second, to determine whether or not it is possible to improve further the one that seems most effective. The results of the work are being compiled and will be prepared for publication as soon as they are sufficiently complete.

JERSEY CATTLE FOR PORTO RICO.

Twenty-one head of Jersey cattle were purchased for the University of Porto Rico and shipped April 17 last. An employee of the Dairy Division proceeded to Porto Rico with the cattle and will remain long enough to develop the dairy farm in connection with the university. The cattle are doing well and the indications are that the project will be successful.

DAIRY ARCHITECTURE AND ENGINEERING.

The architectural and engineering work has become a very essential part of the work of the Dairy Division. During the past year plans have been prepared for two dairy houses, two silos, one dairy-school building, one dairy barn, and laboratories for the Dairy Division in Washington and at Albert Lea, Minn. Drawings have been prepared for several Farmers' Bulletins, and two applications have been made for patents on dairy apparatus. There have been sent out during the year 2,086 blueprints of barns and other dairy buildings. For several months past it has been impossible to supply all of the demands in this line.

Some of the problems to be handled during the coming year are concerned with creamery refrigerators, brine cooling systems, incubators, and other apparatus for laboratory use; also some work in connection with septic tanks and sewage-disposal systems for creameries and farms.

DAIRY PRODUCTS INVESTIGATIONS.

This section is in charge of L. A. Rogers, and includes technical investigations relating to butter, milk, and cheese. A considerable part of the work is carried on in cooperation with state experiment stations, because of lack of proper facilities to do the work in or near Washington.

BUTTER INVESTIGATIONS.

The work in progress relating to butter includes:

1. A study of the morphology and physiology of the bacteria concerned in the souring of milk, to determine methods of separating them into groups, etc. This work will be completed and ready for publication in a short time.

2. The production of a dry starter for use in butter making. Such starters now on the market contain few lactic-acid bacteria and are frequently badly contaminated. Results indicate that this undertaking will be successful, and that it will be possible to dispense entirely with the mother starter. This work will also be completed and the results ready for publication in a short time.

3. The study of factors influencing changes in storage butter. It has been found that acid in the cream causes great changes in the flavor of such butter, and also that overworking tends to increase the air content and to develop bad flavors. Fishy flavor is found to occur only in highly acid butter, and sometimes then only when it was overworked. Experiments proved that butter with excellent keeping quality can be made of pasteurized sweet cream without the use of a starter. These findings are published in Bulletin 114 of the Bureau of Animal Industry. The chemical changes which cause such marked changes in flavor have not as yet been accurately determined. Specific attention is being paid to changes produced by overworking and by proteolysis.

4. A study of the digesting-acid-forming bacteria and their influence on the flavor of butter. On account of their ability to form acid these bacteria persist in milk after other liquefying bacteria are suppressed, hence they frequently develop in large numbers in ripening cream. Such bacteria injure the keeping quality of butter.

5. A determination of the best temperature for pasteurizing cream for butter making, as indicated by the destruction of bacteria and the various enzyms of the milk and by the keeping quality of the butter.

6. Work under factory conditions to determine the relative cost and profit of pasteurization in butter making. The operations in this experiment involve pasteurizing the entire output of the factory for one week and manufacturing the cream raw the next week.

7. A systematic study of butter making under farm conditions, with the object of determining methods of making the best quality of farm butter.

The work projected includes:

1. A study of the chemical nature of the substances causing flavors in butter. An attempt will be made to collect the specific substances in sufficient quantities to make a study of their origin.

2. Determining the relative rate of changes in the flavor of butter stored at different temperatures.

3. A study of the factors causing loss of fat in butter making.

MILK INVESTIGATIONS.

A study of commercially pasteurized milk as found in Washington, D. C., Albert Lea, Minn., Boston, and New York, made to determine the correctness of the hypothesis that commercial pasteurization destroys the lactic-acid bacteria and permits the unchecked development of harmful bacteria, shows that such is not the case. A part of this work will be ready for publication in the near future.

It is planned to undertake a morphological and physiological study of gas-forming bacteria which grow in milk. It is desired also to study from a chemical standpoint the by-products of these bacteria.

It is proposed to investigate also the nonliquefying alkali-forming bacteria which are common in milk, especially when held at a low temperature. The origin of the bacteria and the by-products of their growth are important problems for study.

Investigations in milk secretion are being continued in cooperation with the Missouri Experiment Station. The principal problem to be studied is the effect of feed upon the chemical composition of milk. Before this main question could be investigated, however, there were numerous other questions which it was necessary to understand.

Those portions of the work already completed may be summarized as follows:

1. The influence of breed, individuality, and period of lactation upon the composition of milk. Twelve animals of four breeds were used in this work—Jerseys, Ayrshires, Holstein-Friesians, and Shorthorns. They were fed a uniform ration throughout the entire period of lactation in order that any variation in the composition of the milk due to feed would be eliminated. Some of them were fed throughout two periods of lactation. This made it possible to study the changes that took place due to advancement in the lactation period, to breed, and to individuality.

2. The use of formula in testing total solids. To determine whether or not a reasonably accurate result could be obtained by other means than chemical analysis, data from the main work were used in studying this problem simply as a side issue. A new lactometer was devised, whereby a more accurate reading can be made. This work is now ready for publication.

3. A chemical and physical study of the fat globules in cow's milk. Bulletin 111 has been issued, showing the results of this study.

4. For more than a year investigations have been conducted with human milk. Samples were taken from 12 subjects, mostly colored, of different ages, with nursing children from 2 weeks to 1 year of age. In some cases samples were taken each week for an entire year. About 250 samples of this milk were analyzed. Some very valuable information has been obtained from this study, particularly in comparison with the exhaustive study that is being made along the same line with cow's milk.

The work in progress under this head includes:

1. Effect of gain or loss of fat in the animal upon the composition of the fat secreted in the milk. In studying the effect of feed on milk production it will be necessary to know whether or not the composition of the milk is affected by a gain or loss in body weight; hence the necessity of this experiment.

2. Period of abnormality of milk at the time of parturition. A chemical study is being made to determine more definitely just when the milk is unfit for human food.

3. A comparison of the leucocytes contained in cow's milk and in human milk.

4. A study of the chemical and physical changes in milk from one milking to the next. Information on this subject is particularly important in infant feeding. Five different animals have been studied in this manner so far.

5. A study of the fat and ash in human milk. Very little has been published relative to the chemical composition of human milk fat. It is known, however, to vary materially from the fat in cow's milk. This work is being done when other work is not pressing.

6. A study of the action of rennet on milk. A method has been devised for determining accurately the coagulation period when milk is acted upon by rennet. This determination is being made regularly, and when sufficient data have been accumulated it is possible that some general laws may be deduced.

When the work now in progress is completed, it is proposed to take up the work on the main problem of the effect of feed on the composition of milk. It is planned to begin with cotton-seed meal, since this is known to have a very marked effect on the composition of milk, and will therefore possibly throw some light upon the methods to be followed in continuing such tests.

CHEESE INVESTIGATIONS.

Swiss cheese.—Two men at Albert Lea, Minn., have worked continuously the past year on various problems involved in the manufacture of the Swiss type of cheese, particular attention being given to the use of pasteurized milk. The work has been done without the assistance of a chemist or bacteriologist, and while the results are good, they are as yet not uniform. It is planned to continue the work, going thoroughly into an investigation of the question of starters, also into the chemistry and bacteriology of the whole subject.

Cheddar cheese.—Three men have been engaged in this work, which is done in cooperation with the Wisconsin Experiment Station at Madison. A study is being made of the influence of acid in Cheddar cheese making, to determine the effect of using commercial acid in the milk. The necessity of solving two main questions is apparent: First, how to develop a process of bringing milk to a uniform condition as to acidity and bacterial content, and thus render possible the production of a uniform product; second, to find accurately the factors influencing flavor. A study has been made of the influence of acidity and other conditions on the removal of the moisture content of curd in the vat, and a report of this particular phase of the investigation has been prepared. While the work has so far thrown but little light on the main problems, it has developed a great deal of important information relative to the whole subject of Cheddar cheese manufacture.

Whey butter.—Investigations conducted during the past year show that where a cheese plant handles 10,000 pounds or more of milk as a maximum daily run, whey butter can be made profitably. These results are important alike to the cheese maker and to the farmer who supplies the milk. A report on this subject has been prepared for publication.

SOFT CHEESE INVESTIGATIONS.—This work is being done in cooperation with the Storrs Experiment Station, at Storrs, Conn. These investigations have thus far been restricted to the Camembert and Roquefort types. Three employees of the Dairy Division are engaged in this work—a chemist, a mycologist, and a practical cheese maker. The cheese maker manufactures the cheese and the chemist and mycologist study the exact chemical and biological properties and changes that occur during the process of ripening. Many difficulties have been encountered in this work, some of which have been overcome. There are some problems yet to be solved, but the results so far achieved seem to indicate that eventually it will be possible to manufacture successfully both the Camembert and Roquefort types of cheese in the United States. A report on ''Camembert Cheese Problems in the United States'' has been published as Bulletin 115 of the Bureau.

DAIRY MANUFACTURES.

This section is in charge of B. D. White. The work deals largely with the operations of creameries, cheese factories, etc., and includes a supervision of some of the principal dairy markets. It is aimed to assist the manufacturers of dairy products in the use of better and more economical methods of production, in overcoming difficulties and losses, and in improving the quality of their product.

MARKET INSPECTION.

Inspections of butter in the market have been made during the year as follows: Chicago, 1,250 lots; New York, 1,600 lots; San Francisco, 70 lots.

This inspection is made at the request of the dealer or the producer, and the defects of the butter are pointed out in a letter which in all cases is sent to the producer, giving suggestions as to methods of overcoming them. This work has accomplished sufficient results to warrant its continuation in the cities where it has been tried and to justify its inauguration in a few more of the other more important butter markets.

CREAMERY INVESTIGATIONS.

Assistance is rendered to the creameries throughout the country by a card system of reports and by visits from inspectors. The cards are sent out to the various creameries, upon which the manager or butter maker is requested to fill in certain information and in return is promised that this office will review the card and advise him whether or not the creamery is being handled in the most economical manner. In compiling this information for the Dairy Division the creamery manager incidentally gets hold of the exact information that he needs for his own use. One hundred and forty-six creameries have been helped in this way during the past year, and it is estimated that at least $80,000 have been saved to these creameries.

The returns received periodically from the creameries show that there is a great lack of uniformity in the results produced by the small creameries. For example, one creamery will sell more butter in proportion to the butter fat received than another creamery. Many creameries do not keep accurate records of the amount of butter fat bought and the amount of butter sold, or make tests to determine the losses in the different processes of manufacture. This lack of systematic business method in some cases causes a loss to the creamery of thousands of dollars every year. In order to assist more thoroughly in overcoming these defects five men have been employed during the past year in the States of Iowa, Minnesota, Wisconsin, North and South Dakota, Nebraska, Kansas, Oklahoma, Montana, and California. As a result assistance has been given to 159 different creameries. The inspector, when asked to do so, visits a creamery, studies thoroughly the conditions under which it is operated, and when the difficulties are located helps to correct them, if they can be corrected. It has been estimated that the amount saved to the 159 creameries where this work was done during the past year was $245,000, or an average of approximately $1,500 for each creamery.

An investigation has shown that where the creameries ship their butter only once a week it scores on reaching the market an average of two points lower than similar butter shipped more frequently. Such creameries have been advised, therefore, to adopt a system of shipping much more frequently.

Some of the cooperative creameries are built by promoters, who charge approximately $2,000 more for a creamery than it should cost if built by the creamery company. The Dairy Division has undertaken, therefore, to supply new companies with articles of incorporation, by-laws, a list of machinery needed, blueprints for buildings, etc., and in this way has done considerable good, not only in saving the creameries this $2,000 in money but often by advising against the erection of creameries in localities where it is impossible for them to succeed.

It is important that this work should be continued and increased, as a great deal of money is lost through the ignorance with which a very great part of the creamery business is conducted.

INSPECTION OF BUTTER FOR THE NAVY.

During the latter part of 1908 there was inspected on request of the Navy Department 350,000 pounds of butter for the Navy. During the spring of 1909 the manufacture of 800,000 pounds was begun, at five different points, and this butter was inspected in the usual manner.

NEW WORK.

The extensive use of farm separators at present makes the loss of fat in skim milk through their use an important consideration. Some work has been done to determine the amount of such loss on the average farm, but this work has not progressed far enough to warrant definite conclusions.

Other subjects under consideration for future study are the consumption of fuel in creameries, the manufacture of casein, the manufacture of condensed milk, proper business methods in the operation of cheese factories, and the manufacture of ice cream at creameries.

MARKET MILK INVESTIGATIONS.

The work of this section, which deals mainly with the improvement of milk supplies, is done very largely in cooperation with state and city health departments. A representative of the division, on visiting a city that has requested assistance, first familiarizes himself thoroughly with all the local conditions that affect the handling of milk. He discusses the various phases of the situation with the city authorities. Public meetings are arranged for producers, consumers, physicians, etc., in order that all may take a part in the discussion of the work that is being planned. The division representative frequently spends several days with the dairy inspectors, giving them assistance in scoring dairies, that they may become familiar with the use of the score-card system. This system of dairy inspection has been adopted in 64 cities where Dairy Division employees have worked during the year. The number using the score card previously was 61, making a total of 125 cities that have now adopted the system. In addition, 165 other cities have been given assistance through correspondence or visits, making a total of 290 cities, located in 39 States, that have been assisted by the Dairy Division. A summary of the score-card work shows that to date 29,970 dairies have been rated by means of the card, the average score being 52 per cent.

A few facts that indicate the advantage of the score card are here given:

At Syracuse, N. Y., 312 dairies during 1907–8 averaged a score of 51.4. During the following year, 380 dairies averaged 68, an increase of 32 per cent in the rating.

At Cleveland, Ohio, 3,758 dairies supplying milk to that city during 1907–8 scored an average of 47.9, while 5,000 dairies supplying the city in 1908–9 made an average score of 58, showing an improvement of 21 per cent.

The 250 dairies supplying milk to Memphis, Tenn., averaged 50 in 1907–8, and in 1909 they scored 60, an increase of 20 per cent.

Of the dairies supplying milk to Nashville, Tenn., 160 in 1907–8 scored an average of 62.5, and 183 in 1908–9 scored an average of 70.9, an increase of 13 per cent.

In Richmond, Va., 108 dairies supplying that city made an average score in 1907 of 41.5; in 1908 they averaged 74; a gain of 78 per cent.

Ten cities, containing over 5,000 dairies, that have been scoring these dairies for the past two years and furnishing the results to this office reported an average score for 1907–8 of 49.03. The average score one year later, 1908–9, was 59.20. This shows an average gain of 10.17 points, or 20.7 per cent.

These data bring out two very important facts: First, that the average score of dairies is very low, and, second, that this low standing can be quickly raised by the use of the score-card system. This system is very highly commended by health officers who have used it.

During the year 110 public lectures have been made by the workers in the market-milk section, and it has been necessary to refuse a number of applications owing to lack of sufficient help. Assistance has been given in 3 city, 8 state, and 2 national milk exhibitions, in which there were a total number of 438 entries, and in 3 dairy-farm contests with 145 entries.

Investigations have been in progress at Round Hill, Va., during the past year with regard to the following subjects: Contamination caused by dust in the air of the dairy house; the number of bacteria in milk cans when returned from dealer; the effect of sunning milk cans; the efficiency of cooling by means of the cooling vat, tubular cooler, and conical cooler; a bacteriological comparison of the open-pail method of milking with that of the adjustable can. The results of this work indicate the advantage of milking directly into the milk can by means of a funnel attachment. A combination milk pail, shipping can, strainer, and stool was devised by Dr. Lee H. Maynard, of the Dairy Division, and used in these experiments. This device has been described in an article appearing in the Twenty-fifth Annual Report of the Bureau. The Department has applied for a patent, so that the apparatus may be used by any person in the United States free of royalty.

RENOVATED-BUTTER INSPECTION.

The work of inspecting renovated or "process" butter and the factories where it is produced is in charge of Maj. M. W. Lang, with headquarters in Chicago. The supervision of this product is carried on in accordance with the act of Congress of May 9, 1902. During the past fiscal year 43 renovated-butter factories were in operation, located in 13 States, practically all, however, being in the Middle West. The total volume of this trade for the past fiscal year showed some diminution when compared with the previous year. The total quantity manufactured last year was 47,432,276 pounds, a decrease of 3,225,882 pounds. There was a corresponding falling off in the export trade also, the total of which was 1,115,288 pounds, a decrease of 156,322 pounds. The total number of inspections of factories for the year was 144. The number of samples tested for moisture was 228, of which 193 were found below the standard of 16 per cent.

REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Washington, D. C., September 30, 1909.

Sir: I have the honor to submit herewith a report of the work of the Bureau of Plant Industry for the fiscal year ended June 30, 1909.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

GENERAL WORK OF THE YEAR.

The funds appropriated for the work of the Bureau of Plant Industry for the fiscal year ended June 30, 1909, aggregated $1,348,576. Of this amount $187,410 was for statutory salaries, chiefly of the clerical staff; $258,000 for the work connected with the purchase and distribution of seeds; $6,900 from a special appropriation of $10,000 made for the purpose of testing plants suitable for paper manufacture and used jointly by this Bureau and the Forest Service; and the remainder, $896,266, was appropriated for the maintenance of the various lines of investigation, experiment, and demonstration conducted by the Bureau throughout the country. In addition to these funds the sum of $50,000 became available on March 4, 1909, from the appropriations for the fiscal year 1910 for the purpose of making an immediate extension of the farmers' cooperative demonstration work in boll-weevil sections of the South where there was the greatest demand for such work. A portion of this sum was accordingly used before the close of the fiscal year 1909.

BUSINESS OPERATIONS.

The correspondence of the Bureau during the past year has involved the preparation of replies to more than 200,000 letters covering practically the whole field of plant industry. In addition numerous inquiries were answered by means of circulars and other publications. In connection with the fiscal operations of the Bureau 8,500 requisitions for supplies were issued; 13,133 accounts were received, audited, and paid; 168 requests for contracts and leases were made;

531 letters of authorization and amendments thereto were drawn; and 1,620 letters of instruction to field investigators were prepared. A great deal of correspondence has been disposed of throughout the Bureau by the preparation of typewritten circulars by a duplicating process, a total of 103,775 copies of such matter having been prepared by one operator during the past year.

From September 1, 1908, to August 31, 1909, the following changes in the personnel of the Bureau were made: Resignations, 109; deaths, 4; dismissals, 3; transfers from the Bureau, 24; and furloughs and terminations of appointments, 335, making a total of 475 employees dropped from the rolls during that period. There have been made in the same period 708 appointments, resulting in a net increase in the total force of the Bureau of 233. On September 1, 1909, the numerical strength of the Bureau was as follows: In Washington, 527; outside of Washington, 692; total, 1,219. The total number of employees in the Bureau on the same date a year ago was 986.

PUBLICATIONS.

The handling of the printing and publication work of the Bureau has continued, as heretofore, in charge of Mr. J. E. Rockwell, Editor. A total of 94 publications was issued by the Bureau during the past fiscal year, containing 2,610 pages, 42 plates, and 256 text figures. Of these, 28 bulletins or parts of bulletins were issued in the special Bureau series, 10 in the Department series of Farmers' Bulletins, 22 in the series of numbered circulars inaugurated during the preceding year, and 30 as unnumbered circulars. The annual report of the Chief of the Bureau for 1908 and reports on the progress of the beet-sugar industry in the United States in 1907 and in 1908 appeared during the year. To the Yearbook of the Department of Agriculture for 1908 this Bureau contributed eight papers on subjects of timely interest, which were subsequently reprinted for distribution in separate form.

The demands upon the Bureau for its publications issued in previous years resulted in the reprinting of 63 bulletins or other papers, containing 1,136 pages, 134 plates, and 163 text figures.

In addition to its publications, the miscellaneous printing required by the Bureau involved the issuance of 1,381 requisitions and the necessary preparation of the matter for the printer and the reading of proofs.

ORGANIZATION AND POLICY.

The Bureau organization effected several years ago, by means of which its work is carried on under project groups, has been continued without any great modification. As now organized, the Bureau consists of 30 separate and distinct branches, each embracing a group of problems closely related to each other. There is of necessity much interrelation of these branches of work, and in such cases the work is conducted cooperatively between two or more offices. The field side of the Bureau's work is being continually strengthened by the establishment of new testing stations or the extension of cooperative relations with public or private agencies. In the propaganda for better and purer seeds the Bureau has found it expedient to establish branch seed-testing laboratories at various points in cooperation with the state agricultural experiment stations. Three of these will be in operation during the coming year, being located at Lincoln, Nebr., Columbia, Mo., and Corvallis, Oreg. Likewise, the work in the development of a profitable agriculture in the arid and semiarid regions of the West and Southwest, especially that in cooperation with the United States Reclamation Service, is being extended to cover this entire area. The Bureau now has cooperative work on seven of the reclamation projects and has also effected cooperative relations with nearly all of the western agricultural experiment stations in this work.

COOPERATION WITH OTHER BUREAUS.

In the last report mention was made of several of the lines of cooperative work being prosecuted jointly by this Bureau and other branches of this or of other departments. This work has been continued and augmented, until now the majority of the offices of the Bureau are cooperating with other bureaus in certain phases of their work. The experiments and demonstrations on the Indian reservations have been very successful, and arrangements have been perfected with the Indian service for undertaking additional work of this kind on a number of reservations, notably those at Shiprock, N. Mex., and Pyramid Lake, Nev. The farm at Sacaton, Ariz., on which this work was begun, is being rapidly developed.

With the Forest Service the cooperative investigations already under way have been continued, and a new joint line of work just undertaken with that Bureau has reference to the growing of suitable fruit and ornamental trees around the rangers' cabins in the National Forests, with a view to provide them with a home fruit supply, as well as to improve their home conditions. The work of devising methods for the improvement of the grazing areas of the National Forests has been very successful, as has also been the cooperative work in the eradication and control of poisonous plants found thereon.

During the past year the Isthmian Canal Commission has requested this Department to undertake work with a view to the improvement of agricultural conditions in the Canal Zone, and preparations have been made to send one of the experts of the Bureau to the Zone to ascertain what can be done along this line. It is believed that the Canal Zone offers a very promising field for fruit culture and that with the opening of the canal the conditions of marketing would be very good. The production of home fruits and vegetables is also believed to be a matter which should be encouraged among the residents and employees in the Canal Zone.

COTTON STANDARDIZATION.

Carrying out the authority vested in the Secretary of Agriculture by Congress, a committee of representative men engaged in various phases of the cotton business met in Washington on February 1, 1909, to act in the capacity of expert advisers in the establishment of commercial grades of cotton. This committee spent three days in the consideration and discussion of the various matters involved, which resulted in the submittal of a formal report to the Honorable Secretary unanimously recommending the establishment of nine different grades of cotton, in accordance with the types representative of each grade which were prepared by the committee and delivered to the Department. Suggestions were also made to the Secretary regarding the practical questions involved in the preparation and distribution of the standards. It was the express wish of the committee that the Government should at all times maintain the strictest supervision of the preparation of the standards and that they should be safeguarded in every way by such legislation as might be necessary to prevent their being handled or tampered with. It was strongly urged by the committee that steps be immediately taken to secure the concurrence of foreign exchanges in these standards, and owing to the fact that at the present time transactions on the exchanges in America are made in contracts fully a year ahead, it was believed that in order to avoid confusion the standards certified should not go into use in the trade prior to September 1, 1910. Preparations are being made to bring these standards to the attention of the cotton exchanges in this country, as well as in foreign markets which deal in American cotton.

PLANT NUTRITION.

The work of this Bureau on plant nutrition, to which much attention has been given during the past year, is an outgrowth of the work on various phases of the subject carried on before the organization of the Bureau by the divisions of Vegetable Physiology and Pathology, Botany, Pomology, and Gardens and Grounds. In their practical culture the question of feeding plants is of great importance. While the principal elements of plant food are similar for most plants, every crop has its peculiarities, which must be understood in order to secure healthy, vigorous, and satisfactory growth. In the refinement of modern horticulture and agriculture it is not sufficient simply to furnish the plant with available nitrogen, phosphorus, potash, water, etc., but we must supply the kinds and amounts of food which experiments and investigations have shown to produce the results desired. There is the closest interrelation between quality of product and variety of plant food supplied, temperature, light, and other environmental and cultural conditions. The knowledge of how to control these factors to produce the desired results is the art of the expert cultivator. There was a time when this art and its higher development were confined to the more intensive branches of horticulture, but now we find it evident among fruit growers, market gardeners, cotton growers, corn growers, and beet growers, and in many other branches of general agriculture.

The need of knowledge of this kind is becoming more and more evident. A great deal has been learned by experience, and many of the state agricultural experiment stations, as well as European investigators, have added much to the scientific knowledge of the feeding of crops.

While the work on these subjects in the Bureau of Plant Industry is not centralized in any one office, it is carefully correlated, and an attempt is being made to secure information along the lines of greatest importance from both the practical and scientific standpoints. Our farm management office is collecting and systematizing data as to the practices of the best farmers in the use of farm manures and commercial fertilizers, in the feeding of crops, and in the maintenance of the supply of plant food in the soil. Our crop specialists are comparing the various practices and testing new combinations with a view to the production of more and better plant products, and our physiological and pathological laboratories are studying the effects of various fertilizers and combinations of fertilizers on the normal and abnormal nutrition of plants. In addition, the bacteriological laboratories are studying the relations of bacteria, fungi, and algæ to plant nutrition, while the Physical Laboratory is cooperating with the other laboratories in measuring and determining the physical conditions of soil and atmosphere that affect the crops under investigation.

In view of the fact that all of the factors affecting plant growth must be considered in investigations of this kind, it is necessary to have the cooperation of several of the bureaus of this Department and of a number of the state agricultural experiment stations. As a general rule this cooperation has been freely furnished, and this Bureau has rendered similar services in return. There is increasing evidence that in complex problems of this kind the very closest cooperation is necessary in order to secure the most valuable results.

A detailed report of the various investigations of the Bureau bearing on plant nutrition will be found farther on in this report under the branches of the Bureau which are conducting work of this kind.

INVESTIGATIONS, EXPERIMENTS, AND DEMONSTRATIONS IN PATHOLOGY AND BACTERIOLOGY.

The work of the Bureau in the study and control of plant diseases, both in the laboratory and in the field, has continued along the lines indicated in previous reports, with very successful results. Closely related to the pathological work is that in soil bacteriology and water purification, which has been conducted as heretofore, with the exception of the studies of water contamination, which are now confined to farm water supplies. Brief reports on the progress made in the pathological and bacteriological work follow.

LABORATORY OF PLANT PATHOLOGY.

The general laboratory work in pathology has continued, as heretofore, under the direction of Dr. Erwin F. Smith, Pathologist. Considerable progress has been made during the past year, and additional light has been thrown upon the cause and prevention of a number of plant diseases of bacterial origin.

Bacterial brown-rot.—Additional experiments with the bacterial brown-rot of potatoes, tomatoes, tobacco, and eggplant have shown beyond doubt that the organism enters the plant very readily through broken roots, and for this reason it is advised in transplanting tomatoes and the other plants mentioned to use young plants and exercise great care not to injure the root system. A very considerable quantity of water appears to be necessary in the plant tissues in order to bring about infection. For this reason it is desirable to avoid planting on wet land where the growth will be extremely lush. If such lands are to be planted, they should first be underdrained. It is advisable also to avoid planting on land subject to root nematodes, since the organism is known to enter the roots through wounds made by these worms.

Bacterial disease of sweet corn.—Experiments have shown that Stewart's bacterial disease of sweet corn spreads readily on the seed, probably almost exclusively in this way, and that exposure of the dry kernels of sweet corn to one part by weight of mercuric chlorid in one thousand parts of water for a period of twenty minutes will destroy the bacteria without injury to the germination. This method of disinfection is recommended for general use in connection with the planting of sweet corn, since the bacterial disease is becoming widely prevalent.

Crown-gall and other diseases.—In cooperation with Dr. C. O. Townsend, of this Bureau, investigations of some special plant diseases which are of great economic importance have been carried on. The most important of these is the so-called "crown-gall," which is very destructive to a large variety of plants. It has been shown that the hard-gall and the hairy-root of the apple are both due to bacterial infection. Substantial progress has been made in studying the characters of the organisms producing the galls and their relation to the various gall formations. It is hoped to be able to discover or to develop strains of plants resistant to these organisms or otherwise to prevent their work of destruction. Our work to date indicates that some important results may be expected along these lines.

The investigation of coconut bud-rot, both in the laboratory and in the Tropics, has been continued and good progress made. A paper on the subject is in preparation. The investigations of rice blast and other diseases of rice, formerly conducted in connection with this laboratory, have been transferred to the Office of Grain Investigations and will be referred to farther on in this report.

PATHOLOGICAL COLLECTIONS AND INSPECTION WORK.

The work connected with the economic collections of pathological material and the inspection of seed and plant material has continued in charge of Mrs. Flora W. Patterson, Mycologist. Many valuable specimens have been obtained through the medium of the mycological exchange which has been maintained in connection with this work, and it is hoped that a large amount of the material thus accumulated may be prepared for distribution.

Value of the collections.—The importance of maintaining as large a collection as possible of pathogenic species and related forms is felt more and more as the increase in the scientific force of the Bureau augments the number of those who must constantly refer to the collections for comparative examination. Frequently references to literature are incomplete or lacking altogether, thus making the existence of a permanent and comprehensive pathological collection an absolute necessity. All sets of American exsiccati have been purchased as issued, as well as all foreign sets which the limited funds permitted.

In addition to the purely pathological collections, a distinct collection is maintained of diseased plants in which the trouble has been produced by some cause other than a known organism. This collection includes the so-called "physiological diseases," resulting from improper nutrition and unfavorable weather conditions, and shows the effects produced by insects, the injurious effects of spraying, and injuries by gas or from other unfavorable environmental circumstances. This collection is indexed by host and name of trouble, if a name is known, so that it is easily available for consultation.

Pathological inspection.—The inspection of material received by the Office of Foreign Seed and Plant Introduction has involved the examination of approximately 2,000 consignments of seeds and plants. Certificates, after inspection, have been given permitting the distribution of the material. Inspections have also been made of 150,000 plants sent out from the Department greenhouses and from other offices of the Bureau.

The danger of introducing disease being great, the aim is to make the inspections as thorough as possible, and frequently before reaching a decision the suspected fungus must be cultivated or the host plant isolated and treated in the quarantine house. In order still further to guard against disease introduction, during the preparation of each foreign order the literature of the country is searched and a record made of the pathogenic species of the region. In this way a geographic index of fungi not yet reported in America is being acquired.

Miscellaneous cooperative work.—In cooperation with other offices of the Bureau, various pathological problems are being worked out. Experiments are under way looking toward the control of the destructive pineapple fungus Thielaviopsis. The amount of fumigation necessary to inhibit the growth of the fungus in cultures has been determined, but the effect of the gas on the fruits requires further investigation.

Special attention is being given to diseases of ginseng, alfalfa, and tobacco, systematic and cultural work with the two latter being carried on in the interest of investigators in the field. A series of investigations has been made demonstrating the presence of a fungus in the tissues of lemons, seriously affecting their keeping qualities. Other cooperative work has consisted in systematic and cultural studies of entomogenous fungi, especially of those on insects attacking cultivated plants; and cultures and identifications have been made to assist in the quantitative studies of molds in bleached and unbleached oats which are being conducted by the Office of Grain Standardization.

DISEASES OF COTTON AND TRUCK CROPS.

The investigations of cotton and truck diseases, as well as the plant-disease survey, have continued under the immediate charge of Mr. W. A. Orton, Pathologist, assisted by Messrs. W. W. Gilbert and L. L. Harter. The work on cotton diseases is now far advanced and consists chiefly in the dissemination of the improved disease-resistant varieties developed in the course of the Bureau's work.

Cotton diseases.—The wilt disease of cotton and the often-associated trouble root-knot have continued to spread until they constitute one of the most serious problems in the sandy soil of the cotton belt. The resistant varieties Dillon and Dixie, bred by this Bureau, have proved wholly successful, however, and where our advice concerning rotation of crops is followed complete relief is secured. The problem now is to bring these varieties and methods of rotation and seed selection to the attention of the thousands of farmers who need them. In this work the cooperation of the Office of Farmers' Cooperative Demonstration Work of this Bureau has been secured, with gratifying results.

Watermelon wilt.—The new wilt-resistant watermelon has been further tested and has proved resistant to wilt, of exceptionally good quality, a very long keeper, and a good shipper when grown in the district where it was bred. Trials which have been made in other sections indicate that change of location induces a reversion toward the original type and that it may be necessary to adapt a variety to other sections by local selection.

Potato diseases.—The work on potato late-blight and disease-resistant varieties conducted for the past four years in cooperation with the Vermont Agricultural Experiment Station is being brought to a close. While the dry season of 1908 prevented any test of resistance to late-blight, very valuable data were secured concerning resistance to early-blight, which is a more important disease over the country as a whole the present season. The work was marked by the most successful results from hybridization which have yet been secured.

Malnutrition of truck crops.—The work on diseases induced by improper fertilization has been continued on a larger scale at Norfolk, Va., with results fully confirming those of last year. Large areas of the best trucking soils are becoming less productive each year, and in extreme cases the crops are badly diseased. We have found that this condition can be quickly remedied by the use of chemical fertilizers, together with the use of stable manure, lime, and green manures. This is a problem of great interest to the entire trucking belt and will merit further extension.

Cabbage storage trouble.—A preliminary study of the cause of the decay of cabbage in winter storage has been made, and it has been found that while much of the loss can be prevented by improvements in the construction and management of storage houses, there is need for a vigorously conducted field study of methods of lessening the loss from black-rot and leaf-blight and for demonstrating the results of careless handling.

Miscellaneous diseases of crops.—In addition to the cucumber spraying work, mentioned in previous reports, these demonstrations have been extended to include the pickle-spot (*Cladosporium cucumerinum*) in Michigan. A study of the root-rot of tobacco due to *Thielavia basicola* has been completed during the year, and the results published in bulletin form. In connection with the work on truck diseases, considerable attention is being given to a study of the practicability of controlling the pod spots of beans and peas through the use of pure seed.

Plant-disease survey.—The collection of data on the general prevalence of plant diseases has been continued on a larger scale, and a comprehensive survey is this year being made of the area surrounding San Antonio, Tex. The usual article on the prevalence and spread of plant diseases was contributed to the Yearbook of the Department.

FRUIT-DISEASE INVESTIGATIONS.

The investigations, experiments, and demonstrations in the control of the diseases of orchard and other fruits have continued in charge of Mr. M. B. Waite, Pathologist, with Dr. C. L. Shear in immediate charge of investigations of diseases of grapes and small fruits and Mr. W. M. Scott in charge of spraying demonstrations. The amount of miscellaneous investigational work has increased considerably during the year, and the scientific force has been augmented to meet this additional demand.

Prevalence of fruit diseases.—The season was about an average one for plant diseases over the United States as a whole, some sections faring worse and some better than during the preceding year. The deciduous fruits of the Pacific Coast have been somewhat less affected by fungous diseases than they were during the previous season. On citrus fruits, on the other hand, fungous troubles have increased in amount. Through the Middle West and eastward to Virginia and Maryland apple-leaf diseases have made a marked increase in severity. The severe outbreak of peach yellows in the Eastern States from Connecticut to eastern Tennessee appears to have been somewhat reduced.

Pear-blight eradication.—In California pear-blight eradication work has been continued, though on a somewhat smaller scale, as the matter is largely now in the hands of the growers themselves. The results continue to be satisfactory, although this is due again, as last year, partly to favorable climatic conditions and to the apparently lessened severity of the attacks on the orchards by pear-blight. Success has been achieved almost directly in proportion to the thoroughness with which the eradication methods developed by the Department have been carried out.

In the Rogue River Valley of southern Oregon, where Mr. P. J. O'Gara was stationed during the greater part of the year, one of the most thorough and persistent efforts in eradication was carried out. This is one of the most successful cases on record, particularly as the blight was attacked just as it was entering the district, scarcely any serious loss to the orchards having been permitted. In only two or three orchards were any considerable number of trees lost before the eradication work was carried out. It remains to be seen whether complete eradication can be accomplished in the Rogue River Valley.

Little-peach and peach yellows eradication.—Some investigational work has been conducted on the disease known as little-peach, but the main work has been the continuation of the eradication test for the purpose of ascertaining and demonstrating the value of this method in controlling little-peach and peach yellows. This work was carried on in the Youngstown District in Niagara County, N. Y., in cooperation with the experiment station at Cornell University. The three years' test was concluded last season with fairly satisfactory results, the percentage of disease being reduced to a comparatively small figure.

Pecan scab.—During the past year investigations of pecan and other nut diseases were taken up by this office. A regular series of experiments was started in South Carolina on the pecan scab. The experiments indicate that pecan scab can be controlled by careful spraying with fungicides. Many interesting pathological facts relating to the disease have been worked out.

Russeting or spray injury to apples.—For several years past the amount of damage caused by Bordeaux mixture spraying, particularly on Ben Davis apples, has been increasing. Some other varieties, such as the Winesap, Jonathan, Grimes Golden, etc., show this trouble to a less extent, while the York Imperial, Yellow Newtown, Rhode Island Greening, and some other varieties are little affected. Bordeaux mixture is probably the best fungicide known so far as its actual effect in killing fungi is concerned. During the rainy seasons, however, it not only russets the fruit but causes serious injury to the leaves and sometimes serious defoliation. A set of experiments was undertaken in orchards at Winchester, Va., to find some way of avoiding this difficulty. Eight different fungicides were tried in comparison with ordinary Bordeaux mixture, two of these being new or modified mixtures. The indications are that the trouble can be avoided by the use of other fungicides, among which, apparently, self-boiled lime-sulphur is the least harmful and the most satisfactory as a fungicide for most purposes. In the apple spraying experiments where Bordeaux mixture was used in comparison with the self-boiled lime-sulphur for preventing fungous diseases a similar result was obtained favorable to the self-boiled lime-sulphur wash. The boiled lime-sulphur, such as is commonly used for dormant spraying, was also tried, greatly diluted, for summer use, and gives promise of becoming a satisfactory substitute for Bordeaux mixture, but further experiments are necessary to determine the exact status of these sulphur mixtures.

Demonstration spraying.—The demonstrations in spraying for the control of apple diseases which have been conducted in the Ozark mountain region during the past three years were practically completed last fall. Similar work is now being conducted in northwestern Missouri and in Virginia. The successful control of such destructive diseases as apple-blotch, bitter-rot, and leaf-spot was thoroughly demonstrated in the Ozarks, and the leading fruit growers followed the example set by the Department.

Peach brown-rot.—From time to time during the past fifteen years pathologists in various parts of the country have vainly endeavored to develop a satisfactory treatment for brown-rot of stone fruits. At a conservative estimate the annual loss from this disease easily exceeds $2,000,000, and the fruit growers have been helpless to prevent it. The recent experiments of the Department have shown that this disease may now be largely controlled by the use of the new self-boiled lime-sulphur spray. The experiments with this spray have been carried on for three years, and during the present season the work was conducted on a commercial scale, and the practicability and efficiency of the treatment were very successfully demonstrated.

Orchard nutrition.—Work on the nutrition of fruit trees has been taken up by this office during the year. Considerable scattered work had been done, however, previously. A series of fertilizer tests was started in commercial orchards around Winchester, Va., to study the effect of fertilizers on healthy and diseased trees. These tests will be continued for at least three years.

Miscellaneous orchard diseases.—Various orchard-disease problems have been investigated during the year. One of the troubles with young apple trees in the spring of 1909 turned out to be oil injury, due to the separation or imperfect working under certain conditions of the miscible oils used in spraying. A number of other diseases have been studied in the field and laboratory, such as apple powdery mildew on the Pacific coast and diseases of the apricot, almond, and cherry in California.

Grape diseases.—Work on grape diseases has been continued by Dr. C. L. Shear and his assistants in New York, Pennsylvania, Michigan, and New Jersey. The spraying experiments have shown that the black-rot can be satisfactorily and profitably prevented by proper spraying with Bordeaux mixture. It has also been found that the 4–3–50 formula gives as good results as larger quantities of the constituents. Bulletin No. 155 of the Bureau of Plant Industry, presenting the results of the grape-spraying experiments for black-rot during the past three years, has been published. Life histories of several of the fungi affecting grapes have been worked out in the laboratory. This work is to be continued during the year 1910.

Miscellaneous diseases of small fruits.—The work on cranberry diseases has been confined chiefly to Massachusetts and Wisconsin. Further work on these diseases is to be conducted. As a result of the work in New Jersey, many of the growers are purchasing and installing large spraying outfits and are successfully combating the two most serious diseases—scald and rot. Studies of the life histories of anthracnoses and of other fungi have been successfully continued. Further work along this line and also investigations of miscellaneous diseases of other small fruits are to be carried on during the year 1910.

INVESTIGATIONS IN FOREST PATHOLOGY.

The field and laboratory work on diseases of forest and ornamental trees and shrubs has continued in charge of Dr. Haven Metcalf, Pathologist, with Drs. George G. Hedgcock and Perley Spaulding engaged in the investigation of definite groups of problems. Close cooperation with the Forest Service in all of this work has been maintained.

Chestnut bark disease.—The chestnut bark disease, probably the most rapid and destructive of any affecting forest trees, has now spread south to Virginia, west at least to central Pennsylvania, and north to Rhode Island. Investigations by Doctor Metcalf and Prof. J. F. Collins show that where the disease is already established nothing can save the trees. General quarantine methods, if conscientiously applied, would probably check the advance of the disease into new localities. Experiments made on Long Island have shown conclusively, however, that under orchard conditions the disease can be controlled by a definite pruning and cutting-out system. Bulletin No. 141, Part V, of the Bureau of Plant Industry, "The Present Status of the Chestnut Bark Disease," gives the results of the work on this disease up to the current season.

White-pine blight.—Continued researches by Doctor Spaulding in the New England States have shown that what is called "white-pine blight" is in reality a complex of diseases, none of which is especially serious. Owners of white pine may be assured that there is little to fear from this disease, and there is no reason why reforestation with white pine should be further delayed. Circular No. 35 of the Bureau of Plant Industry, "The Present Status of the White-Pine Blight," has been issued on this subject.

Peridermium strobi on the white pine.—This disease was found by Doctor Spaulding in New York in June, and further observations have since demonstrated its presence in Vermont, New Hampshire, Massachusetts, Connecticut, and Pennsylvania. The States concerned, with the advice and cooperation of this office, have acted vigorously in taking up eradication methods, and it is hoped with success. This disease was introduced in the spring of 1909 from Germany on white-pine seedlings. In many parts of Europe it prevents the growing of white pine, and there is no reason to assume that it would be less serious in America if once established. It will be necessary to continue observation and eradication for two more years in order to be sure that the disease has not obtained a foothold. The problem of keeping the disease from being again imported is a serious one, since no system of inspection will suffice to distinguish healthy from diseased seedlings in certain stages. Circular No. 38 of the Bureau of Plant Industry, "European Currant Rust on the White Pine in America," gives the present status of our knowledge in regard to this epidemic.

Mistletoe diseases.—Investigations of various mistletoe diseases have been continued by Doctor Hedgcock, and a bulletin on the common mistletoe, especially as it occurs in Texas, is now in press. This bulletin is by Prof. W. L. Bray, a collaborator of this office.

Miscellaneous diseases of trees and woods.—Experiments on the damping-off of coniferous seedlings have been continued, but on account of the pressure of the emergency work on the eradication of *Peridermium strobi* less has been accomplished on this particular problem than in previous years. Experiments have been made in Vermont, New York, Nebraska, Colorado, and California. Results indicate that treatment will have to be varied greatly according to the species of tree and the local conditions.

The pathological aspects of the rotting of structural timber have received increasing attention. In the future one member of this office will devote his entire time to this work, in close cooperation with the Office of Wood Preservation of the Forest Service.

Forest-disease survey.—The general survey of the forest-tree diseases of the United States, and especially of the national forests, has been continued by Doctor Hedgcock. This work is bringing to light much new and valuable information regarding the prevalence, seriousness, and spread of many tree diseases.

SOIL BACTERIOLOGY AND WATER PURIFICATION.

The investigations and experiments in general soil bacteriology, in the use of pure cultures of nitrogen-fixing bacteria for leguminous crops, and in the improvement of farm water supplies have continued in charge of Mr. Karl F. Kellerman, Physiologist, along the lines mentioned in the last report.

NODULE-FORMING BACTERIA.—The distribution of pure cultures of the nodule-forming bacteria for legumes has been continued. As a result of the successful use of these cultures during the past few years there seems to be a revival of interest among the farmers in inoculation, and during the ensuing year nearly twice as many cultures will be distributed as during last year. Perhaps the most interesting feature of our latest results is the benefit due to pure-culture inoculation where leguminous crops are planted in regions that are naturally supplied with the proper bacteria. In such cases either the natural forms of the nodule organism are less vigorous or they are not present in sufficient numbers to produce the best results.

Our investigations upon the possibility of adapting cultures of the nodule-forming bacteria to adverse soil conditions are being continued, and the data thus far secured indicate that we may eventually be able to prepare satisfactory cultures for regions which at present are very unfavorable to inoculation.

As a result of our investigations of the value of inoculated legumes for green manure for tobacco it was found that the turning under of a crop of inoculated vetch makes it possible to reduce the quantity of nitrogenous fertilizers about one-half. The results of these investigations have been published in Circular No. 15 of the Bureau of Plant Industry.

GENERAL SOIL BACTERIOLOGY.—The investigations in general soil bacteriology are being continued in a more specialized form. At Logan, Utah, in cooperation with the Utah Agricultural Experiment Station, we are investigating nitrification and bacterial development with special reference to the action of irrigation water. At Fallon, Nev., in cooperation with the Office of Western Agricultural Extension of this Bureau, investigations upon organic decay and nitrification, both in the desert land and in the land under irrigation, are being carried on. In cooperation with the Office of Grain Investigations of this Bureau and with the Bureau of Chemistry, we are carrying on investigations on the effect of climate upon the normal soil flora. For this purpose blocks of soil containing approximately 100 cubic feet have been transferred in as nearly as possible their natural condition between California, Kansas, and Maryland. These investigations must continue several years in order to allow these blocks of soil to become thoroughly acclimated. The investigations at Norfolk, Va., in cooperation with the Office of Diseases of Cotton and Truck Crops of this Bureau and with the Virginia Trucking Association, show a very intimate relationship between the bacteriological conditions and certain of the peculiar physiological troubles of the truck crops of that region.

FARM WATER SUPPLIES.—Investigations in water purification during the past year have been carried on chiefly within the State of Minnesota. In informal cooperation with the Minnesota State Board of Health an exhaustive sanitary reconnaissance of the farm water supplies of that State has been made, and the data collected show that farm water supplies generally are in rather bad condition and that in most cases they could be rendered safe by simple and inexpensive changes, such as the installation of tight casings and coverings and protection against surface drainage. A bulletin embodying the results of these investigations is in press.

CROP PHYSIOLOGY AND BREEDING INVESTIGATIONS.

The investigations formerly carried on under the group title of "Plant Life History" have, with the broadening and development of the work, been given the name indicated above and are conducted, as heretofore, under the immediate direction of Mr. Walter T. Swingle, Physiologist, with Mr. Charles J. Brand, Physiologist, in charge of clover and alfalfa investigations and Prof. S. C. Mason, Arboriculturist, in charge of the dry-land arboricultural and general work in the Southwest. These investigations are concerned primarily with the determination of the factors underlying the physiology of crop production. The need of such investigations is especially obvious in the newly settled regions of the West and Southwest, where the settlers have to meet conditions never before encountered by peoples of northern European extraction.

BREEDING AND ADAPTATION WORK WITH FRUIT AND NUT CROPS.

During the past year considerable attention has been given to the establishment of the date and fig industries in this country, as well as to the introduction or improvement of various fruits and nuts.

Caprification and breeding of figs.—Since the establishment of the fig insect in this country a great impetus has been given to the Smyrna fig industry, and a large number of orchards of the Lob Ingir (commercial Smyrna) have been set out in various parts of California. Inasmuch as we import something like 2,000 tons of Smyrna figs annually, valued at $800,000 at the port of entry, it can be seen that the status of this industry is likely to be a matter of considerable importance. In order to secure a crop of figs of the Smyrna type, male figs, called profichi, borne on caprifig trees, must be suspended in the branches of the Smyrna fig tree. This operation of hanging the male figs in the Smyrna trees is called caprification. In setting out an orchard of Smyrna figs the caprifigs do not come into full bearing as soon as the Smyrnas, and in the case of the smaller growers it is often impossible to secure enough caprifigs to caprify the edible figs. For this reason this office has leased a 3-acre fig orchard at Loomis, Cal., planted some twenty-five years ago to seedlings of the best Smyrna figs. About one-half of these seedlings are good edible varieties, the other half being caprifigs. These caprifigs are placed at the disposal of fig growers, the smaller growers being given the preference in the distribution.

Cooperative fig-breeding experiments.—Believing that the breeding of fruits and other crop plants will ultimately be done on the farm by the farmers themselves and by their children, an attempt has been made to decentralize the work in the breeding of figs and to interest growers in these experiments. In studying the seedling fig orchard at Loomis, Cal., it has been found that a large number of valuable new varieties have originated there, some of them particularly well adapted to the soil and climatic conditions of that locality.

Cuttings of these varieties have been distributed gratis to all those desiring to test them, under the condition that for each cutting received three seedling figs be planted out and cared for. The result of these experiments has been to interest growers in the breeding of new varieties, and there can be no doubt, in view of the results at Loomis, that a fair proportion of these seedlings will turn out to be good edible varieties, some of them equal or superior to the best imported sorts, with the additional advantage of being originated on the particular farms where they are to be grown. It is believed that in this way thousands of new varieties particularly adapted to American conditions will be originated and that American varieties will ultimately lead the world in quality and productiveness.

THE PISTACHE NUT.—The investigations on the pistache nut, which have been under way for some years, now give promise of yielding some very interesting results. Through Mr. Frank N. Meyer, of the Office of Foreign Seed and Plant Introduction, it was possible to secure a large supply of seed of the Chinese pistache (*Pistacia chinensis*), known for years as the hardiest wild pistache available as a stock. Mr. Meyer's investigations in the field have shown also that it reaches large size and is a handsome ornamental. It is believed that this will prove to be an even better stock upon which to graft the cultivated pistaches than the *Pistacia terebinthus* of southern Europe, of which it has been impossible to secure a sufficient supply of seed.

The *Pistacia atlantica* of north Africa and the *P. mutica* of western Asia, although able to grow in unusually dry situations, have proved to be of rather slow growth and not well suited for use as stocks under ordinary conditions of fruit culture in the Southwest.

It is believed that the pistache, which is the most expensive nut that reaches the American market, can be grown profitably throughout many parts of the Southwest, wherever the fig and almond are now grown. Many thousands of stocks have been distributed, and a special effort is being made to work out methods of propagating the pistache with a view to the rapid multiplication of budwood of the improved varieties, which alone are in good demand on the American market.

DATE CULTURE.—The investigations on the date palm are becoming of very great interest, and the date gardens at Tempe, Ariz., Mecca and Indio, Cal., and Laredo, Tex., are now beginning to produce fruit. It is rapidly becoming possible to narrow down the number of varieties which it is desirable to test on a commercial scale to a dozen varieties or less. Particular interest has been aroused by the almost universal favor with which dry dates have been received by those who have tested them. This is a type of date unknown to American and European consumers. These dates are quite hard and firm and can easily be kept for several years if protected from weevils. The Arabs, who consume immense quantities of dates, claim that such varieties are more healthful than the soft or candied sorts used by Americans. The dry dates have a particularly rich, nutty flavor.

The plan for the cooperative breeding of new date varieties has been continued during the past year, and some 300,000 seedlings are now growing in various parts of Arizona, California, and Texas. It is hoped that within the next year this number will be increased to almost a million. A fair proportion of the seedlings yields edible fruits, and many promising new varieties are being originated. The foundation is in this way being laid for the breeding of distinctly American varieties of dates far superior to anything now grown in the oases of the Old World. Already the cooperative date gardens of this country can show a finer assortment of choice date varieties than can be found in any other date region in the world.

Breeding hardy types of citrus fruits.—The citrus breeding work, conducted by Mr. Swingle with the assistance of Mr. E. M. Savage, has yielded interesting results during the past year. Some of the hardier citrange trees planted in northern Georgia and other parts of the cotton belt withstood during the winter of 1908–9 temperatures as low as 10° F., and even lower, without injury. The citrange makes an attractive ornamental tree, covered with white flowers in spring and with golden fruits in autumn. The fruits are a substitute for the lemon for home use, and, though they have no commercial importance, they are finding much favor in the South and Southwest.

The citrange is a cross of the orange with the hardy deciduous *Citrus trifoliata*. It has been found that some of the plants lose their leaves during exceptionally cold winters, while others are evergreen. In the spring of 1907 Mr. E. M. Savage made crosses between oranges and citranges—that is, hybrids having three-quarters orange blood and one-quarter trifoliata blood. Some interesting results are being obtained from these three-quarter hybrids, and there is every reason to believe that they will yield fruits sufficiently sweet for table use and at the same time possessing some of the hardiness of the *Citrus trifoliata*. Three-quarter crosses between the citrange and the trifoliate orange have also been made by Mr. Swingle, with the idea of securing a perfect deciduous and hardy hybrid which can be grown far to the north. This is a promising field, and good progress is being made along this line.

Dry-land olives.—During the past year Prof. S. C. Mason has prepared the manuscript of a bulletin on the drought resistance of the olive in the Southwest, describing fruit orchards in dry regions which for one cause or another have been without irrigation for a number of years, showing in a striking way the drought-resisting qualities of the olive. Practically all other fruit trees in these orchards died out, while the olive not only survived but in some cases continued to yield fruit. There can be no doubt that the olive is the most drought-resistant fruit tree known at the present time. In cooperation with Mr. Thomas H. Kearney, of this Bureau, work is now under way in the testing of the most drought-resistant varieties of the olive at various points in the southwestern United States.

Desert almonds.—A comparatively little known group of fruit trees belonging to the genus Prunus and representing the nearest American relatives of the peach, almond, and apricot has been made the subject of considerable study by Professor Mason. Four species of this type grow wild within the limits of the United States, each bearing small, dry fruits something like the almond. At least one of these species has been successfully used as a stock upon which to graft the ordinary almond in dry localities. The other three are now being investigated with a view to making practical trials to determine their relative value as stocks for the almond and other stone fruits. These investigations are under way in California, Arizona, Nevada, and Texas. A fifth species, probably belonging to this same group, is the so-called Texas "wild peach" (*Prunus glandulosa*). This is being studied with reference to its possible value as a dry-land stock in some parts of the Southwest. It yields a small but palatable fruit something like the peach. Hybrids between it and the plum have already been made and are now under observation.

CLOVER AND ALFALFA INVESTIGATIONS.

The work on clover and alfalfa has been continued by Mr. Charles J. Brand, and good progress has been made along a number of lines.

TESTS OF RED CLOVERS.—The work so far as concerns red clovers has been largely confined to continuing an experiment begun several years ago which has for its purpose the securing of a strain of this valuable plant hardy enough to endure the severe winter conditions of the northern Great Plains. Six strains, one each from Ohio; South Dakota; Orel and Ufa, Russia; Berne, Switzerland; and Reading, England, are being carried through a series of seed generations at Dickinson, N. Dak., in cooperation with the North Dakota subexperiment station. About 60 species of clover are being grown for seed production and study at Ettersburg, in Humboldt County, Cal., a region where many clovers occur in a wild state.

SHAFTAL, A NEW CLOVER.—Seed and hay production studies of shaftal (*Trifolium suaveolens*), the promising annual clover originally secured in 1906 from the Himalayas in northwestern India, have been continued and a new importation of seed has been secured by correspondence through Mr. Philip Parker, experimental officer of the Indian Irrigation Service. Another and larger lot of seed was secured in Turkestan by Prof. N. E. Hansen on his last trip. Experiments to test the usefulness of this species in the cotton belt of the South in rotation with corn and cotton have already been begun.

GRIMM ALFALFA.—The investigations of this valuable alfalfa, planned in 1904 and begun during the following spring, have now progressed to a point where positive recommendations as to its use can be made. Experiments thus far conducted indicate that this is the hardiest variety of *Medicago sativa* of which we have knowledge. In an experiment in cooperation with Prof. L. R. Waldron at the North Dakota subexperiment station, at Dickinson, 68 strains of alfalfa, including two Grimm alfalfas of slightly different heritage, were as nearly as possible subjected to identical conditions and treatment in hill and drill rows. This spring, after a winter of normal severity preceded by a moist autumn, the winterkilling in the 68 kinds was found to range from 3 per cent to 100 per cent. Seven-eighths of the varieties lost over half of their stand. Of the nine strains that lost less than half, only two lost less than 10 per cent. Both of these were Grimm alfalfa. Farmers of the Northwest are deeply interested in alfalfa, and especially in the Grimm strain. Efforts are being made to establish a Grimm alfalfa seed industry in order to safeguard farmers in making their purchases of seed.

Peruvian alfalfa.—The propagation of acclimatized and locally adjusted strains of seed of the valuable Peruvian alfalfa is going on at various points in Arizona and California. The first seed crop on the increase plat in the cooperative testing and demonstration garden at Sacaton, Ariz., has been harvested and the second seed crop on the same plat is well along toward maturity. At Yuma, Ariz., the method of transplanting crowns which appears to be fairly common on the Andean plateau, but which so far as is known has not been put to practical use in this country, was employed with great success. In less than six months from the time of transplanting a mature seed crop was secured. The applicability of this method to the middle and northern Great Plains, where alfalfa is grown without irrigation, has been tested during the present season, and the method gives excellent promise of success.

Alfalfa testing stations.—Study collections of living plants comprising practically all of the alfalfas introduced by the Bureau and also many strains secured by breeding have been established to make possible a test of these forms under different climatic conditions. The most important of these stations are located at Dickinson, N. Dak., in cooperation with the branch experiment station at that point; at Stockton, Kans., in cooperation with Mr. E. Bartholomew; and at Sacaton, Ariz., at the cooperative testing and demonstration garden operated by this Bureau in conjunction with the Indian Service. Less complete collections are maintained at Yuma, Ariz; Fallon, Nev.; San Antonio, Tex.; Nephi, Utah; and Indio, Cal., and at Guelph, Indian Head, and Brandon, Canada; at the last three points in cooperation with the Dominion experiment stations located thereat. The total number of strains now being grown for study and observation at these stations exceeds 250.

COOPERATION WITH THE INDIAN SERVICE.

The cooperative work with the Indian Service has been carried out along the lines indicated in the last report. The work on the Pima Indian Reservation at Sacaton, Ariz., has been continued and extended and minor cooperative work has been undertaken on several of the near-by dependent reservations.

Testing and demonstration garden, Sacaton, Ariz.—The cooperative work at Sacaton, with Mr. William L. Flanery as foreman for the Bureau of Plant Industry and Mr. M. French Gilman representing the Office of Indian Affairs, has made excellent progress during the past year. Experiments in the acclimatization and testing of Egyptian cotton have been continued in cooperation with other officers of this Bureau. Some 20 acres were grown last season and picked by Indian labor. This crop was selected by an expert, ginned and baled, and held to be marketed with this year's crop by the Office of Indian Affairs, when it is hoped to obtain a fair idea of the profits of this extremely promising crop for the Southwest. Cotton culture can hardly be a success in central Arizona unless Indian labor can be used, and for this reason the experiment being made on the reservation at Sacaton, where there is a large supply of Indian labor, will be very important.

Nearly an acre was planted to Bermuda onions last season after preliminary experiments had shown that the climate and soil around

Sacaton were especially well adapted for their culture. The Indians have shown much interest in this work, and it is believed that a very superior quality of onions is being produced, owing largely to success in excluding all insect and fungous pests.

Assortments of offshoots of the best imported varieties of date palms have been set out at Sacaton, as well as citranges, dry-land tree crops, alfalfa, and other crops. The work at Sacaton promises interesting and valuable results.

Cooperative work at Shiprock, N. Mex.—A cooperative testing and demonstration garden is being started on the Indian agency farm at Shiprock, N. Mex., under the direct supervision of Mr. W. T. Shelton, superintendent of the reservation. This farm contains over 300 acres under irrigation in the San Juan Valley at an altitude of 4,500 feet. The climate is equable throughout the year, the temperature rarely falling as low as zero in winter or going above 90° F. in summer. Corn is cultivated successfully by the Indians, and white settlers at Farmington, a few miles up the valley, grow excellent crops of peaches and other fruits. The climate is believed to be unusually well adapted for the culture of stone fruits and various other new crops, particularly if drought-resistant stocks can be found. With this in view, it is proposed to secure all obtainable varieties of peaches from the hot, dry regions of the Old World and to experiment with these on all available stocks to secure the desired result. Much attention will also be given to the breeding of hardier types of subtropical fruits, such as figs, citranges, persimmons, pomegranates, etc., for which this location is well adapted.

Experiments at Pyramid Lake, Nevada.—The Pyramid Lake Reservation in Nevada comprises a large tract of fairly rich land surrounding Pyramid Lake, and it is proposed to inaugurate a small testing and demonstration garden there, in cooperation with the larger station of the Office of Western Agricultural Extension on the Truckee-Carson Reclamation Project at Fallon, Nev. It is believed that this will prove an excellent location for working out some of the special problems of crop physiology and breeding. One of the things to which attention will be given is the utilization of the "desert almond" (*Prunus andersoni*) as a drought-resistant stock upon which to graft various stone fruits. This desert almond grows wild about Pyramid Lake, and it is believed that no better stock can be found for the almond in semiarid regions where no irrigation is feasible.

DRUG-PLANT, POISONOUS-PLANT, AND GENERAL PHYSIOLOGICAL INVESTIGATIONS.

In its general outlines the work on drug and other special crops and on poisonous plants, of which Dr. Rodney H. True is Physiologist in Charge, has been conducted as heretofore. Several new problems have been taken up, while others have been carried to completion or to a point where they require comparatively little attention.

DRUG-PLANT INVESTIGATIONS.

The drug-plant work comprises two general lines which are interdependent, the field work, involving primarily the cultural and handling phases of the study, and the laboratory work, dealing with more technical matters, such as active principles, physiological properties, and special methods of preparation for market. General interest in the subject of our native drug plants has appeared to warrant a series of publications describing and illustrating the most used crude drugs and the plants producing them, which has been partially completed. Two numbers, dealing, respectively, with roots and barks, have appeared, and further numbers dealing with herbs, leaves, flowers, and fruits are in course of preparation.

ARLINGTON, VA., TESTING GARDEN.—At Arlington, Va., a large number of kinds of medicinal plants of both native and foreign origin are under study in small plats. During the past year the number of native kinds now known to drug commerce in a wild state only has been considerably increased. Owing to the general tendency of this class of drug products to diminish with the clearing of the land and with the continued activity of the itinerant drug collector, it seems desirable to obtain information concerning the cultural conditions demanded by these plants before they have become too far depleted, commercially speaking. The introduction of foreign plants, made through the Office of Foreign Seed and Plant Introduction, has been continued. Work on the breeding of drug plants has been actively begun along several lines, especially with the more potent and variable sorts. The laboratory equipment at Arlington for working up these experimental products on a larger scale has been brought to a fair degree of completeness.

The destructive methods used in obtaining the valuable native bark known to the drug trade as cascara sagrada, derived from *Rhamnus purshiana* DC., have led to a series of experiments looking toward the growing of the tree under cultivation. This bark is taken in very large quantities from wild trees growing in the moist climate of the upper Pacific coast region. Two peelings have been made from the experimental trees at Arlington, with a favorable outcome. The results of this work have been brought together for publication. In the work at Arlington it has also been shown that *Cannabis indica*, the Indian hemp, a valuable drug imported from India and Africa, can be grown successfully in this country and that it yields a product equal in physiological activity to the imported article.

SOUTH CAROLINA TESTING GARDEN.—In South Carolina the work on growing red pepper for the spice market has been continued on an increased scale. Attention has been paid chiefly to the rather pungent Hungarian type of paprika pepper. About 20,000 pounds of dried paprika pods were grown, cured, and sold to spice grinders, chiefly in New York, although smaller shipments were sent to Chicago and Cincinnati dealers. The American-grown pod ground with the seed, but without the stems, was accepted by the Board of Food and Drug Inspection as satisfactory. In view of the unsatisfactory condition of the paprika supply offered from abroad, this ruling was very gratifying. A larger crop of the Hungarian type has been planted this season by farmers cooperating with the Department, and a small area of the sweet Spanish type of paprika pepper has been put out in the hope of gaining a foothold for an American product of this sort.

DRUG-PLANT WORK IN FLORIDA AND TEXAS.—In Florida the drug plant work has been largely dominated by the more extensive camphor project, to be described later. A number of perfumery plants have been grown, with promising results. This applies especially to the Indian oil-bearing grasses *Andropogon citratus* (lemon grass) and *A. muricatus* (vetiver). A number of native plants rich in volatile oils have been kept under test, with very interesting results. In general, cultivation has a very marked influence in increasing the size of the plant and the yield of oil. At Pierce, Tex., the work has not shown the same measure of success seen at the other gardens. A number of kinds of plants thrive excellently and, so far as natural conditions are concerned, seem promising, but the labor conditions are very unfavorable for handling the crop, owing to competition from rice farmers and others. For this reason the work at this point has not been extended.

New garden at Madison, Wis.—Cooperative arrangements having been made with the School of Pharmacy of the University of Wisconsin for the establishment of a testing garden at Madison, various kinds of plants have been placed at this point for test. This additional station, it is hoped, will yield information concerning the behavior of drug plants under more rigorous climatic conditions than are met with at any of the other gardens.

Camphor investigations.—The camphor seedlings from Florida and from foreign sources have made good progress. Although it is commonly believed that camphor seedlings require shade, seed sown in the open has yielded a fair crop of plants. These plants are undersized when compared with those grown in the shade, but the expense involved in providing shade makes it appear possible that seedlings grown in the open may prove more profitable.

Further observations for a series of years may be required to settle the question of permanent advantage. The experimental factory is being gradually equipped for operation.

Camphor trees planted at Pierce, Tex., on the dense clay rice land of that section continue to thrive. From the standpoint of plant growth this part of Texas might seem to offer a favorable opportunity for developing the commercial culture of camphor, but the high value of the land and the rather difficult labor problem seem serious drawbacks when compared with the situation in Florida.

SPECIAL PROBLEMS.

In connection with the drug-plant work various related problems are being worked out in the handling, production, and utilization of certain special crops or plants of economic importance.

Perfumery-plant investigations.—Under this heading is grouped the series of projects dealing with plants producing essential oils. Native and introduced plants yielding volatile oils are being studied in the various testing gardens, chiefly at Arlington, Va., and at Orange City, Fla. Through the cooperation of the Office of Foreign Seed and Plant Introduction, stocks of Algerian and Spanish geraniums have been imported for testing in Florida. Among the native, uncultivated flora there are many oil-bearing plants that have never been adequately investigated with respect to their possible utilization. The black sage (*Artemisia frigida*), abundant on the Great Plains east of the Rocky Mountains, has been shown to yield an oil of much promise from the perfumer's standpoint. The white sage (*Ramona stachyoides*), abundant on dry lands in southern California, yields an oil also likely to prove of economic importance. Other species of wild plants have also been found to contain valuable oils, which will be the subject of later detailed reports.

HOP INVESTIGATIONS.—The hop-breeding work undertaken on the Pacific Coast, in charge of Dr. W. W. Stockberger, Pharmacognosist, has been continued with very interesting results. Selections from plants of American varieties, crosses between German and American sorts, and incrossed foreign sorts have been under the close observation of this office. The present chaotic condition of the standards governing the price of hops has been the subject of some consideration. A circular which has been issued pointing out these facts and urging the need of a change has been much in demand. The study of the value of various hop constituents as a basis for judging hops has been continued.

TANNING AND DYE PLANT INVESTIGATIONS.—With the passing of the forests the tanning industry has found increasing difficulty in obtaining a satisfactory supply of tanning materials. This has resulted in an increasing importation of extracts, barks, etc., from abroad. In view of this situation the question of the growing of tannin crops as farm products seems worthy of investigation. A preliminary survey of the field during the past year has resulted in the arrangement of a series of experiments with promising tannin crops.

LEMON INVESTIGATIONS.—During the past season a study of the conditions of lemon curing and sweating with reference to the long keeping of the fruit in the market has shown that the two chief sources of loss are (1) decay apparently due to mold infection, probably following injury, and (2) decay caused by parasitic fungi which seem to infect the fruit in California, but which do not reach visible development until after the lemons have been stored for some weeks. A circular reporting the chief results of this study appeared during the year. A further investigation of the curing and sweating processes involved in preparing lemons for market is in progress.

TEA-CULTURE INVESTIGATIONS.—The tea work in cooperation with Dr. Charles U. Shepard at Summerville, S. C., has been continued with special reference to the devising of labor-saving machinery, particularly for the pruning process. A feasible type of machine seems to have been devised which, with such improvements as experience may suggest, should considerably diminish the cost of pruning tea. A study of the different methods of handling this crop has been continued, careful records being kept, together with a record of meteorological and other conditions, so as to make possible a comparison of weather conditions with tea yield. The aspect of the Summerville experiment has been very encouraging, the tea having found ready sale at a relatively small cost of putting on the market. The grading and preparing of the tea for market have been somewhat modified so as to give a wider range of prices without diminishing the total income from the crop. The outlook for the new season is very good, weather conditions thus far having been very favorable, and the gardens seem more productive than for some time past.

The tea experiments at Pierce, Tex., have been discontinued, owing to the continued difficulty with climatic and labor conditions, which seem to discourage the hope of a successful tea industry in that region for the immediate future.

POISONOUS-PLANT INVESTIGATIONS.

During the past few years the importance of the relation of poisonous plants to the grazing interests has been increasingly recognized. With the decreasing area of the open ranges the animals have had closer attention than formerly and the losses have been observed in greater proportion than before. Moreover, the narrowing of the grazing areas has tended toward an overstocking of the range, with the result that the vegetation is more closely fed than formerly and harmful plants that would not be eaten if an abundance of wholesome plants were available are consumed. During the past year the grazing States of the West have made a very considerable demand for aid and information in the matter of plants poisonous to stock. The field investigations on poisonous plants are conducted, under the immediate supervision of Doctor True, by Dr. C. Dwight Marsh, Physiologist, while the laboratory work is carried out by Dr. Carl L. Alsberg, Chemical Biologist.

Loco-weed investigations.—The main emphasis of the year's work has been laid on the loco investigations. The feeding work at Hugo, Colo., was directed chiefly toward the relation supposed to exist between the presence of barium in the loco weeds and their poisonous effect on stock, and involved the antidoting of the poisonous principle of the plant. A summing up of the field work on the loco disease prior to last summer was made in Bulletin No. 112 of the Bureau of Animal Industry, submitted for publication from this Bureau.

Larkspur poisoning.—In cooperation with the Forest Service, a station has been established this season at Mount Carbon, Colo., for the study of larkspur poisoning of horses, cattle, and sheep, and work on this important source of loss has been begun. This investigation deals with several species of larkspur which at different altitudes appear at different seasons. The work, although but recently begun, has already developed important evidence.

Milksickness and its cause.—Last autumn information was received of an outbreak of milksickness in Illinois and a representative of this office made a study of the plant conditions to be observed on the premises visited by this disease. There seems to be no reason for the tradition which connects the white snakeroot (*Eupatorium ageratoides*) with the occurrence of this malady. Incidentally, investigations along other lines have been made, both at the seat of trouble and in the laboratory at Washington, and it is believed that important evidence has been obtained concerning the cause of the disease.

Cooperation with the Forest Service.—On account of the large number of cases of stock poisoning occurring in the national forests, the Forest Service has been cooperating with this office in a study of the conditions in the forests most affected. A number of botanical reconnaissances were carried out on the suspected areas, and it was usually found possible to identify plants open to suspicion. In some cases suggestions looking toward an abatement of losses were made, such as change of trail to avoid poisonous areas. In other cases it seemed probable that the fencing of limited areas of poisonous plants would be justified, while sometimes the digging out of the poisonous plants seemed practicable.

PLANS FOR FUTURE WORK.

During the ensuing fiscal year the work along drug-plant, poisonous-plant, and general physiological lines should proceed along the same general plan as at present.

Drug-plant testing.—It is hoped that a testing garden may be established in some suitable location in the Southwest for the testing of the plants producing jalap, gum arabic, myrrh, tragacanth, colocynth, and other important drug products. In connection with the drug-growing work a careful investigation should be made of the possibility of influencing the amount of active principle through the use of plant-breeding methods. In order that authentic information may be obtained concerning foreign-grown drugs and in the hope of securing their cultivation in this country where practicable, the introduction through the Office of Foreign Seed and Plant Introduction of all kinds likely to succeed in any part of the United States should be made.

Perfumery plants.—The work on perfumery-plant problems has opened up a very important line of work among our native oil-bearing plants. Many members of our flora have undoubted possibilities as useful culture plants. A study of plants of this class seems to be required. The application of the methods of the plant breeder to some of the established oil-yielding plants has already shown promising indications, and the widening of the application of these methods seems to promise valuable results. Since the carrying on of this work becomes quite laborious, additional assistance will be required.

Camphor, hops, and tannin crops.—The camphor investigations must to a certain extent be confined to the working out of methods and to improving apparatus until the experimental plantings reach the size required for actual pruning. This will be possible, since it is easy to obtain experimental material from other sources. The hop work should proceed along present lines, with special emphasis on breeding and on the fundamental characteristics on which to base national standards. The tannin-crop work should be extended to include an increased amount of field testing of promising native and introduced plants. Methods of handling the resulting crops can then be worked out to fit the individual crops and local conditions.

Lemon and other fruit problems.—The lemon work should be continued along the present lines, with special attention to the physiological features of packing-house methods. In this connection the opportunity should not be neglected to look into methods of utilizing the fruit now lost because diseased or otherwise defective. There are a large number of technical physiological problems demanding solution in connection with the handling and storage of fruit of various sorts, as well as with reference to fruit drying and related industries. These investigations involve matters of great economic importance and should be undertaken as soon as possible.

Tea culture.—In view of the advanced stage of the tea problem, it has become possible for the Department to withdraw more and more from the experiment, so that at present the amount of time and funds necessary for the work is a relatively small item. It seems probable that this course can be wisely followed during the next year.

Poisonous plants.—In connection with the poisonous-plant investigations of the ensuing year, it seems important that the loco work should be continued, especially in so far as it is concerned with the active principles of this plant. The work on larkspur will be continued as actively as possible, both in the laboratory and in the field, since the annual loss attributed to this group of plants is very great, and the working out of some effective means of meeting the loss is very desirable. Poison-ivy eradication still remains one of the most urgent poisonous-plant problems of the East, and the tests at present under way should be continued. A large number of poisonous plants, among which are lupines, death camas, wild parsnips, and other members of the parsnip family, demand further study. Both wild and cultivated forage plants when heavily parasitized may become sources of danger and should be investigated. Owing to the withdrawal of the Forest Service from active financial cooperation in the work on the national forests, this phase of the poisonous-plant work will necessarily be conducted on a smaller scale unless additional funds are available.

INVESTIGATIONS OF TECHNOLOGICAL AND OTHER SPECIAL AGRICULTURAL PROBLEMS.

The field and laboratory work of the Bureau with reference to the working out of the various problems in connection with the handling and grading of crops, including seeds and grain, and with various other projects of a special nature, has continued along essentially the same lines as set forth in the last report, with such extension as has been necessary in the development of the work.

COTTON STANDARDIZATION, PAPER-PLANT TESTS, AND GENERAL AGRICULTURAL TECHNOLOGY.

The general technological work, as well as that on the standardization of cotton and the production of plants suitable for paper manufacture, is under the immediate charge of Dr. N. A. Cobb, Agricultural Technologist. Much of the time during the past year has been devoted to the two last-named features of the work, in which good progress has been made. Considerable work has also been done in equipping laboratories for the necessary careful experimental work.

Cotton standardization and baling.—In accordance with law a committee of representative men connected with the cotton industry of this country met in Washington in February, 1909, as previously referred to in this report. This committee unanimously recommended the adoption of cotton standards and submitted a set of types which in its opinion fairly represented the grades of cotton sought to be established. Accordingly preparations for the promulgation of official cotton grades have been going steadily forward, and it is expected during the present calendar year to place sets of the official grades with the principal organizations, associations, exchanges, and agricultural colleges vitally interested in cotton. Before the close of the ensuing fiscal year it is hoped that the work of more generally distributing the official grades by sale will be actively under way.

An investigation has been made of the covering and baling of cotton by Prof. R. L. Bennett, Special Agent. These features of cotton production have long been objects of general complaint, especially with reference to the covering and compressing processes. It is evident that the heavy deductions for tare, or weight of covering, by the final purchasers are the cause of the present complaint. These conditions have led the growers or shippers to put on their cotton a cover which is both heavy and of inferior quality. It is believed that uniform rules relating to deductions for tare and to baling in general should be adopted in the cotton trade.

Paper-plant testing.—Arrangements were made at the beginning of the present growing season with a number of farmers in Indiana, Illinois, Iowa, Kansas, Missouri, and Kentucky whereby corn, broom corn, and other crops are being raised with the twofold object of comparing different varieties when grown under similar conditions to ascertain their comparative fiber value, and of securing material upon which to make paper tests on a large scale. In addition to this work the rice growers' association of Arkansas is voluntarily growing several varieties of rice under conditions as nearly similar as possible, with the same objects in view. Apparatus for the necessary laboratory work has been devised or purchased. Arrangements have been made with large manufacturers of paper whereby tests of the material to be harvested this fall will be made on a commercial scale. It is hoped that when these have been completed the Department will be able to show decisively that paper either can or can not be economically produced on a large scale from cornstalks, broom corn, rice straw, and various other materials which are at present of comparatively little value.

FIBER INVESTIGATIONS.

The work on fiber crops has continued in charge of Mr. L. H. Dewey, Botanist. Hemp has received principal attention during the past year, though experiments with flax, ramie, jute, henequen, sisal, and phormium have also been conducted.

Hemp experiments.—Under present conditions hemp is regarded as the most promising fiber-producing crop for cultivation in the United States. Hemp sown in the spring of 1908 on two of the state farms in Wisconsin, in cooperation with the Wisconsin Agricultural Experiment Station, made an excellent growth and was harvested, retted, and broken under the direction of this office. The hemp was spread for dew-retting early in the fall, but owing to unusually dry weather it was not sufficiently retted before snow fell. Four acres of hemp on one farm taken up before the snow fell were underretted, making it difficult to clean properly, but it produced 4,500 pounds of remarkably strong fiber. The other field of 3 acres was covered with snow and could not be taken up until March. This was overretted, producing 3,900 pounds of rather tender fiber, very soft and light in texture and more easily cleaned. The stalks were more hollow, having a thinner woody shell than hemp from the same kind of seed in Kentucky. Stalks with thin shells yield more fiber and are more easily retted and broken. The yield of fiber is regarded as very satisfactory compared with the average yield in Kentucky, which is about 700 pounds per acre. The experiments in Wisconsin have been continued during the current year, more than 20 acres of hemp having been sown.

In 1908 one field before sowing had been infested with Canada thistle, and both with quack-grass. The Canada thistle was completely killed and most of the quack-grass was destroyed by the dense shade of the hemp. Both of these weeds are very abundant and injurious in Wisconsin, and any crop that will destroy, or even check, their growth will prove very beneficial to the farming interests there.

The cultivation of hemp at Hanover, Pa., has been continued on an increased commercial scale as a result of the cooperative experiments of this office there in 1907. Some experiments in the cultivation of hemp for seed and also for fiber were undertaken in the spring of 1909 in Louisiana. The heavy rains of May and June destroyed practically all of the hemp sown broadcast for fiber, and also much of that planted in hills for seed. Hemp seed from China imported by the Office of Foreign Seed and Plant Introduction has been grown in several different localities under the direction of this office, and some of this seed gives promise of being of a variety of hemp of superior merit.

Fiber work for the ensuing year.—It is planned to give personal supervision to the work of harvesting, retting, and breaking the hemp grown in the cooperative experiments in Wisconsin, and new methods will be tried, with a view to reducing the cost of handling the crop. The selection of hemp for the breeding of improved varieties will be taken up, and an experiment in the cultivation of hemp on the experiment farm of this Bureau at Yuma, Ariz., will also be inaugurated. The seed hemp surviving the storms in Louisiana will be harvested.

Breeding work on flax will be begun and plants will be selected in the fields of flax cultivated for fiber, with a view to developing improved fiber-producing varieties. Methods of sowing, harvesting, and handling the flax crop will be studied. An investigation of the production of ramie fiber in southern California will be made, as well as of the various processes for decorticating ramie. Preliminary experiments in the introduction of henequen and sisal in southern Texas, Florida, and California will be carried on, and similar work with phormium, with a view to the production of this fiber in the Gulf region and in California, will be undertaken.

TAXONOMIC AND RANGE INVESTIGATIONS.

The cooperative work with the Forest Service in the improvement of the grazing areas of the national forests, the botanical studies of grasses and other economic plants, and the maintenance of the economic collections have been continued along much the same lines as heretofore, in charge of Mr. Frederick V. Coville, Botanist.

COYOTE-PROOF PASTURE EXPERIMENT.—A preliminary report on the coyote-proof pasture experiment, planned and carried out by Mr. Coville in cooperation with the Forest Service, was published during the past year as Circular 156 of that Service. The object of the experiment was to ascertain to what extent the large percentage of grass that is lost by trampling under the customary herding system could be saved and utilized under a pasture system similar to the highly satisfactory paddock system of Australia. To do this it was necessary to construct a coyote-proof fence around the area on which the experiment was to be made, for if the sheep were allowed entire freedom in a pasture in which coyotes were free to enter disastrous results from the attacks of these animals would be sure to follow. In the summer of 1907 an 8-mile fence of woven and barbed wire was constructed around 4 sections, or 2,560 acres, of summer grazing lands in the Wallowa National Forest of Oregon. In the spring of 1908 a band of 2,209 ewes and lambs, of Merino and Rambouillet breed, were turned loose in the inclosure and grazed throughout the season. The fence proved absolutely effective as a protection against coyotes, for not one of these animals entered the pasture at any time during the summer, although one or more came up to the fence almost every night. Instead of the usual losses of from 2 to 5 per cent in herded bands the losses in this pasture were only one-fourth of 1 per cent.

At the end of the season the animals, especially the lambs, were far superior in condition to any of the sheep grazed under the herding system on the range surrounding the pasture, although the pasture was somewhat overstocked, with only a little over an acre to each sheep. The pastured lambs averaged 72 pounds in weight when 6 months old, and the largest weighed 90 pounds. They were 10 pounds heavier than lambs of similar class and grade from a band handled by the ordinary herding system on the range immediately outside the pasture. It is clear that, making due allowance for all variations, the pastured area carried at least 50 per cent more stock than like areas on outside range land on which herding was practiced. During the grazing season of 1909 the experiments are being repeated for the purpose of checking the results secured in 1908, and especially to obtain a more accurate comparison of the carrying capacity of lands under the pasturage and herding systems.

NATURAL RESEEDING OF OVERGRAZED RANGE LANDS.—During the past year Forest Service Circular 158, entitled "The Revegetation of Overgrazed Range Areas," containing a summary of the results of the studies in 1907, was issued; and there is now in press another circular, No. 169, entitled "The Natural Revegetation of Depleted Mountain Grazing Lands," which covers the work of 1908. The investigations in 1907 showed that the most important grazing plant on the overgrazed ranges of the Wallowa National Forest was mountain bunchgrass (*Festuca viridula*), that this plant sends up its flower stalks about the middle of July, and that the seed is matured by the first week of September, about three weeks before the end of the summer grazing season. It was determined to apply these facts in an actual reseeding experiment in the season of 1908. A portion of the range of three different bands was closed to sheep during the early part of the season. The mountain bunch-grass developed a good crop of seed, and after this was matured, in early September, the bands of sheep were driven over these seed areas. The sheep knocked the seed to the ground and trampled it in thoroughly, and at the same time grazed off all the grass except the tough seed stalks. An excellent seeding was therefore accomplished without expense and without the loss of the season's growth of forage, which would have been occasioned by closing the area to sheep for the entire season, a plan which was advocated by some of the sheep owners.

The seeds sown as indicated lay in the ground during the winter of 1908–9 and in the spring of the present year developed a very satisfactory germination. An important feature of the experiment is that the stand of mountain bunch-grass seedlings on the areas where the seeds were trampled in by sheep is superior not only to that where the ground was left without treatment, but also to that on areas where the seed was worked into the ground by a brush harrow.

Economic value of the Oregon wild prunes.—In the fall of 1908, while passing through southern Oregon in connection with another project, Mr. Coville took occasion to visit the upper Klamath River region and to secure material of the more promising varieties of the Oregon wild prunes (*Prunus subcordata* and *P. oregana*). In company with an Indian he found nine varieties which have distinct Indian names and possess different qualities. Seeds of the best of these were collected, and arrangements were made for securing scions later. The white settlers of this region regard the preserves which they make from these wild plums as the most delicious of any preserve known to them. The slightly bitter flavor that the fruit possesses is regarded by them as especially desirable, and they have the same liking for it that the Englishman has for the bitter taste of orange marmalade.

In all the varieties collected the stone is so easily separated from the flesh that it can be snapped out by squeezing the ripe fruit. The largest variety seen was about an inch and a half long. The largest trees are about 12 feet high, while the smallest variety produces an abundance of delicious fruit on plants not more than a foot in height. This miniature variety, which did not fruit this year, grows in the upper elevations of the sage-brush belt under conditions of pronounced aridity. On account of the remarkable resistance of these plums to cold and drought, their cultivation is regarded as of great promise, especially in the region in which they grow in a wild state. The vicinity of the Klamath Irrigation Project, where one of the experiment farms of this Bureau is located, offers a good field for the growing of seedlings of these wild plums, the grafting and preservation of all the wild varieties as a living collection, and the breeding of these varieties, both between themselves and with cultivated plums. Work of this kind should be undertaken at an early date.

Domestication of the blueberry.—The experiments looking toward the domestication of the swamp blueberry, which have been carried on for the past three years, have now reached a point where it is possible to outline with definiteness the conditions under which this plant may be propagated and grown successfully in pot cultures.

So satisfactorily have the conditions been worked out that by the combined use of greenhouse and outdoor facilities this plant has been grown in one year from the seed to a maximum height of 27 inches. This is accomplished, however, only by the use of special soils and special treatment. As illustrative of the peculiar requirements of this berry, plants of the same age as those just described grown in ordinary soil, such as is used for forcing roses, were only 2 inches high at the same age. It is expected that a publication presenting the results of these experiments will be issued during the coming year. Meanwhile, experiments in the field culture of these plants have been begun, as well as cooperation with various individuals and experiment stations for the same purpose.

SYSTEMATIC STUDIES OF GRASSES.—An annotated "Catalogue of the Grasses of Cuba," by Mr. A. S. Hitchcock, prepared at the request of the director of the agricultural experiment station of Cuba and based upon collections in the United States National Herbarium and in the herbarium of that station, including the set of Wright grasses in the Sauvalle Herbarium, was published in March last in the Contributions from the United States National Herbarium. A monograph on the North American species of Panicum, a genus of some two hundred species and the largest genus of grasses in North America, is now in manuscript and undergoing final revision. Material of this genus was loaned by nearly all of the large American herbaria, including those of the State universities and experiment stations. The examination of these collections, in addition to the rich collections in the national herbarium, has made possible the accurate determination of specific limitations, distribution, range, and other important questions. For the purpose of obtaining information necessary for the monographic study of other large genera, especially the genus Poa, containing many of the most important economic grasses, field work has been carried on in Alaska and in the Northern States.

USEFUL PLANTS OF THE SOUTHWEST AND MEXICO.—Mr. William E. Safford has continued his work of preparing for publication the extensive notes and journals made by Dr. Edward Palmer in Mexico and in the southwestern United States on useful plants, trees, fruits, fibers, resins, balsams, oils, barks, medicinal products, dyes, tanstuffs, woods, etc., identifying the species to which they belong, fixing accurately the localities cited, and supplementing the information when necessary by obtaining additional material or notes to establish the identity of a plant or tree or to corroborate statements regarding the properties of vegetable products.

ECONOMIC COLLECTIONS.—The work of maintaining the economic collections, in charge of Mr. W. F. Wight, is conducted largely in cooperation with other offices of the Bureau. Material is collected of the various species and horticultural varieties of the plants which are under investigation or test by the offices of Foreign Seed and Plant Introduction, Forage Crop Investigations, and Fiber Investigations, or by the Office of the Horticulturist. This material serves as a part of the permanent records of the offices concerned.

During the past year visits have been made to fourteen of the largest nursery and florist establishments in the country, and collections have been made of large series of specimens of named horticultural varieties of plants, including those grown at the testing gardens of the Bureau at Brownsville, Tex., and Chico, Cal. Special efforts have been made to collect material in the genera Solanum, Hydrangea, Ligustrum, and Prunus, in which special studies of the varieties are in progress. Collections of varieties and new introductions tested at the Arlington Experimental Farm have also been made, to assist in studies of various groups in cooperation with the Office of Foreign Seed and Plant Introduction and that of the Horticulturist.

Identification of plants.—There has been an increase in the number of miscellaneous plants received for identification from the various offices and bureaus of the Department and from other sources. About 4,000 identifications of such material have been made. Many of the seeds introduced by the Office of Foreign Seed and Plant Introduction are received under incorrect names, and a plan was put into effect on February 1, 1908, whereby a sample of each introduction is submitted to this office for identification. Specimens of seeds representing 2,400 numbers of the seed and plant introduction series have been added to the seed collection, the botanical names having been determined or verified as far as practicable. Of these, 400 were received under wrong names.

The increased interest during the last few years in the use of ornamental plants has resulted in greater activity in the production and introduction of new varieties; and since there is no general index or list of the varietal names which have been applied to this class of plants, as there is of botanical names, there is an increasing confusion in their nomenclature. As a basis for the work of establishing a correct and uniform nomenclature of the plants offered in the American trade a collection of the species and varieties of ornamental plants is in preparation. About 3,500 specimens were added to this collection during the year. An index to these varieties of ornamental plants has been begun. Catalogues of 22 of the largest nursery and florist establishments in the United States have already been indexed, the entries now numbering about 15,000.

Botanical study of the potato.—In cooperation with the Horticulturist of the Bureau and the Horticulturist of the Vermont Agricultural Experiment Station a study of the cultivated potato has been begun, with a view to determining the botanical origin of the potato and also whether the varieties which appear to be most resistant to blight are distinct in origin from other varieties. The varieties in cultivation at the Vermont Agricultural Experiment Station have been studied, and extensive collections, amounting to about 430 specimens, have been brought together on the Arlington Experimental Farm. Material of Solanum has also been studied at the Gray Herbarium and the New York Botanical Garden.

SEED LABORATORY.

The work of the Department looking toward the improvement of the quality of farm seeds has been continued by the Seed Laboratory, under the immediate charge of Mr. Edgar Brown, Botanist.

Seed testing.—The general interest in better seeds is shown by the larger number of samples received from farmers and seedsmen each year, as well as by the number of States which have recently enacted laws to regulate the sale of seeds. The Seed Laboratory examines for mechanical purity and germination, under certain limitations, all samples of seed sent in for that purpose, thus enabling farmers to know the quality of the seed they are offered before buying.

Adulterated seed.—The collection and examination of samples of seed for the presence of adulterants has been continued as directed by law. The results of this branch of the work have been very encouraging, as few samples of adulterated seeds have been found aside from Kentucky bluegrass and orchard grass, and a smaller percentage of these was found than in former years.

Vitality of vegetable seeds.—About 3,750 packets of vegetable seeds as offered by local merchants were tested for germination. The results corresponded very closely to those obtained during the two previous years, the average germination being less than 62 per cent. It is important to note that the average germination of the seeds put up by the same firms has, with few exceptions, remained nearly constant. The difference in the quality of the seeds sold by different firms is surprisingly great, the average germination of seeds for three years from one firm being 37 per cent and from another firm 81 per cent.

Cooperative field laboratories.—The work of the branch seed-testing laboratory in cooperation with the Nebraska Agricultural Experiment Station, at Lincoln, has progressed during the year, nearly 50 per cent more samples having been tested than in the previous year. In the fall of 1908 a branch laboratory was opened in cooperation with the Missouri Agricultural Experiment Station, at Columbia, where the work is similar to that at the Nebraska laboratory. More than 400 samples were received for testing, about two-thirds of them being from farmers and the remainder from seedsmen. Some time was spent attending farmers' institutes in Nebraska and Missouri in order to bring to the attention of the farmers the work of these branch laboratories.

Plans for future work.—During the ensuing fiscal year the routine work of seed testing will be continued along lines similar to those now followed. At the main laboratory in Washington special attention will be given to investigational work in seed germination and to the preparation for distribution of sets of authentic samples of seeds, including both cultivated plants and weeds. A new cooperative laboratory will be opened at the Oregon Agricultural College, at Corvallis, in order to serve with greater efficiency farmers and others in the Pacific Coast and Northwestern States.

GRAIN STANDARDIZATION.

The investigations of the Bureau bearing upon the standardization of commercial grain have continued in charge of Mr. John D. Shanahan, Crop Technologist, assisted by Dr. J. W. T. Duvel, in charge of laboratory methods.

Scope of the work.—The work is now being carried forward through a research laboratory at Washington, D. C., and eight field laboratories or stations, six of which are located in large cities where grain markets are established, viz, New York, Baltimore, New

Orleans, St. Louis, Chicago, and Minneapolis. At Decatur, Ill., a laboratory has been opened in connection with the study of grain-transportation problems, and at Fargo, N. Dak., in cooperation with the North Dakota Agricultural Experiment Station, the Bureau has established a laboratory for the testing of the milling and baking qualities of wheat, in order to aid in the determination of proper standards for this grain. The field laboratories were established in order to command, for the systematic study of the important problems underlying the questions of the classing, grading, and marketing of commercial grain, the widest possible range in the conditions of climate, as well as in the kinds, classes, and varieties of grain grown and marketed in the different sections and the methods of grading and handling them at different points in the United States.

Special problems.—In the course of the grain-standardization work special investigations relative to the carrying capacity and quality of grain in its various conditions in transit and storage were found necessary, and these are being actively carried on. Experiments with stored grain are being conducted in cooperation with grain-elevator owners at various seaboard points. As previously referred to, special investigations relating to the flour and bread making qualities of the different wheats grown in different sections of the country, in order to determine in what commercial classes and grades they properly belong, are being conducted in cooperation with the North Dakota Agricultural Experiment Station.

Analyses of grain samples.—During the past year a large number of commercial grain samples have been physically analyzed and reported upon to grain merchants and grain inspectors. Many shipments, cargoes, and carloads of grain have been examined, and considerable attention has been given to the process of artificially drying commercial grain. Much valuable information on these subjects has been gathered and a circular relating to the variation between the loss in moisture content and the actual shrinkage during the process of artificial grain drying has been issued. The work with American cargoes of grain in Europe has been finished and the data obtained are being compiled.

Effect of the investigations.—The work of grain standardization was organized in its present form less than three years ago, and notwithstanding the difficulties at first encountered in securing the full and free cooperation of the grain interests, due to the fact that the objects of the investigations were not fully understood, the work during the past year has had the most cordial support and cooperation at all points, especially from progressive grain merchants, grain-elevator owners, and grain-carrying railroads, and a growing appreciation of the work and the Government's interest in commercial grain problems has everywhere been manifested.

There has also been an increased activity in the endeavors of influential grain interests toward bringing about more uniformity in grain inspection methods and practices, with noticeably desirable results in a number of instances. The reports upon the examination of samples of commercial grain issued from the different laboratories continue, as heretofore, to be used in the adjustment of appeals, disputes, and claims relating to the quality and value of grain. Railroad and grain-elevator companies are becoming interested in the work because of the close relation of some phases of it to a subject of much interest to them, known as " natural shrinkage " in commercial grain.

Improved condition of corn.—The introduction into the grain business by the Bureau of Plant Industry about three years ago of the improved moisture-testing apparatus developed by Messrs. Brown and Duvel has proved an important factor in causing greater care to be taken of corn on the farm by educating the corn buyer and handler in regard to the actual amount of the moisture content and its effect upon values. As a consequence, the open-rail corn crib or pen in the corn belt has almost entirely disappeared.

Plans for future work.—During the ensuing year the work of grain standardization will be carried on along much the same lines as during the year just closed. The study of special problems peculiar to individual points where laboratories have been established has shown that many of these problems have their origin on the farm, either at or after harvest, and more attention will be paid to them from that standpoint in order to determine and show to what extent poor and careless farming methods are responsible for poor classes and grades and the relatively low prices of grain in the markets. During the year an effort will be made to compile the data already obtained in this work and to submit for publication such of it as may be deemed generally useful to the grain industry.

BREEDING AND ADAPTATION WORK WITH FARM CROPS.

The field work of the Bureau in the testing and improvement of our leading farm crops has continued along the same general lines as outlined in the last report. This work covers cotton and corn, the various grain crops, tobacco, sugar beets, and special crops grown in rotation or for soil improvement.

GRAIN INVESTIGATIONS.

The work of the Office of Grain Investigations, under the immediate direction of Mr. M. A. Carleton, Cerealist, has been conducted without material change during the past year, following the established lines with such additions as the development of the work has rendered necessary.

Winter wheat extension.—Having demonstrated the value of hard winter wheats of the Crimean group for cultivation in the middle Great Plains, extensive tests have more recently been made with these wheats by this office in the intermountain dry-farming districts farther west, so far with excellent results. Such varieties are, in fact, likely to be more successful in these districts than in western and northern portions of the Great Plains, where the combination of cold and drought is more severe. The Turkey variety is chiefly employed in these tests, but the Kharkov and other strains have given good results. The Kharkov strain is rapidly increasing in popularity among both millers and farmers, and without question is the most suitable strain for northern Kansas and northward. Certainly two or three million bushels have been harvested in 1909.

Durum wheat.—It is no longer possible to give even an approximate estimate of the production of durum wheat until after the next census is taken, but it is probably not less than 50,000,000 bushels for 1909. Reports of greatly increased yields of durum wheat over those of other wheats continue to come both from farmers and from experiment stations in the semiarid areas. As the dry periods recur, the fact is also emphasized that even the Crimean, or Turkey, winter wheats are not nearly so satisfactory near the one-hundredth meridian as the durums. Even if the present discrimination in price (which on the basis of known merit is unjustifiable) should continue indefinitely, farmers in the western and northern Great Plains should increase their acreage of durum wheat, as the greater yield makes it a more profitable crop, and, furthermore, the production recently has not been equal to the demand. Durum wheat exports continue to be very large compared with those of other wheats, and this is not because of any lack of home demand. During the past year there have been foreign bids for durum wheat at good prices when it could not be furnished. By January 1, 1909, one firm alone had exported 7,200,000 bushels.

The attitude of several of the largest milling firms toward durum wheat has changed remarkably, so much so that the Department is now in receipt of letters from such firms urging its further exploitation. These firms, moreover, have no difficulty with the sale of the flour on the score of color and do not usually practice bleaching, thus confirming the position taken by this Department years ago that it is only necessary to make business connections with the real bread eaters if the milling and baking have been properly done.

Emmer and spelt.—There is now a considerable production of Black Winter emmer among farmers, originating from seed introduced by this Department. Though intended at first to be grown on semiarid lands, it is found to be well adapted also to the Eastern and Central States. Especially good results are obtained in Maryland, Virginia, and Pennsylvania. It ranks well with barley and oats as a stock food and is a more certain crop and contains much more protein than barley. The true spelts, having qualities similar to those of emmer but not so hardy, need to be further tested, but one variety, the Red Winter, has given good results in Michigan.

Proso millet.—The Proso millet, grown usually for the grain, is the most difficult of investigation of all our new cereals because of the great lack of uniform results, but it is at least certain that as a crop it is well adapted to the northern Plains States and that the Black Voronesh is the best of the several varieties so far tested.

Pacific coast grain experiments.—The experiments conducted by Mr. H. F. Blanchard in cooperation with the California Agricultural Experiment Station have been in operation five years. In addition to minor facts learned, by far the most valuable result is the positive one showing the adaptation of Chul and Fretes wheats to the San Joaquin and Sacramento valleys. After knowing their agricultural adaptation for some time, more recent experiments have shown that they are excellent as milling wheats and are far superior in this respect to the native varieties. As this one result is the chief object for which these investigations were undertaken, its value can not be overestimated.

Amarillo, Tex., experiment farm.—The operations of the farm at Amarillo, Tex., at present superintended by Mr. John F. Ross, have continued along practically the same lines as at the beginning four years ago. There is already much evidence of their good effect upon general agriculture in the Texas Panhandle. The results of the work, good or bad, are open for inspection at the farm; exact exhibits of products are made at the district fair; and the superintendent and others connected with the farm take part in local farmers' institutes, thus extending in this manner the information obtained in the work.

Influence of environment on the composition of grain.—The series of experiments conducted during the past four years in cooperation with other offices of this Bureau and with the Bureau of Chemistry has given ample confirmation of the idea that the composition of the wheat kernel is affected by a change of locality. Complete destruction of the crop by hail in several instances has interfered to some extent with these experiments. During the past year a soil-exchange experiment has been begun which now allows the consideration of the soil factor in connection with that of climate in such a way that the influence of each may be determined. Other cereal crops besides wheat have been added to these environmental experiments.

Cereal plant nutrition experiments.—The nutrition experiments with cereals, begun some time ago in cooperation with the Bureau of Chemistry through Dr. J. A. Le Clerc, have recently furnished some important facts. It is shown that in cases of the disappearance of certain plant foods from the plant without taking part in its nutrition these substances have not gone backward through the roots into the soil, but have been excreted on the surface of the plant and been washed off by rain.

Dry-land grain investigations.—During the past year the work in dry-land grain investigations has been extended so that at the present time comprehensive series of experiments are under way at ten different stations located in representative dry-farming sections of the Great Plains and mountain States. This work is being conducted in close cooperation with other offices of the Bureau interested in dry-land agriculture, as well as with the state agricultural experiment stations. The work is now under way at the following points: Amarillo and Dalhart, Tex.; Akron, Colo.; Bellefourche and Highmore, S. Dak.; Williston and Dickinson, N. Dak.; Philbrook, Mont.; Nephi, Utah; and Moro, Oreg. These investigations are under the immediate charge of Mr. W. M. Jardine, Agronomist, assisted by a competent corps of field agents, one of whom is located at each station in the field.

Although these experiments in their present form have been running but three years, the results thus far obtained in determining the most suitable varieties of crops to grow and the best dates and rates of seeding have proved of great assistance to both old and new settlers. During the past year winter wheat was grown for the first time at Williston, N. Dak., as much as 40 bushels per acre of the Turkey variety having been produced. The results secured this year from a series of experiments inaugurated to test the relative yielding value of wheat kernels of different sizes under dry-land conditions showed marked variations and promise to give valuable and much-needed information regarding the quality of seed grain.

The tests with winter wheat to determine the best time of seeding brought out the fact more forcibly than ever before that the earlier the seed is planted after August 15, provided the moisture conditions of the soil are at all favorable, the greater will be the percentage of winter survival.

Special attention is being directed to the breeding of hardier winter wheats, oats, barley, and emmer, with promise of valuable results. In addition to the work with grains, experiments with varieties of potatoes and the interchange of seed potatoes grown under irrigation and on dry land are being conducted.

GRAIN SORGHUMS.—Work with these important dry-land crops has been continued by Mr. Carleton R. Ball along several lines, including the improvement of standard varieties, the testing and selection of recently improved sorts, the distribution of seed to cooperating farmers, the cooperative study of the insect and fungous pests of sorghum, and other equally important problems. Standard varieties of milo, kafir, and kowliang are still under improvement for earliness, productiveness, and adaptability to machine handling. A dwarf strain of Blackhull kafir, comparable to dwarf milo, has been produced. It is much earlier than ordinary kafir, only about a week later than milo, and likely to be of value at high altitudes and latitudes in the sorghum belt. Some of the hybrids between Blackhull kafir and White durra are growing in increase plats and will soon be ready for limited distribution, and a series of hybrids between milo and kafir is under selection.

Seed of improved early strains was distributed in large quantities to cooperating farmers in western Kansas, eastern Colorado, and northern New Mexico and to selected localities in States north and west. Selected seed of standard varieties was sent to farmers in nearly every county of western Oklahoma, western Texas, southern New Mexico, and southern California. Brown kowliang was distributed on a large scale for the first time.

RICE INVESTIGATIONS.—The rice work, under the immediate charge of Mr. Charles E. Chambliss, Expert, has been greatly expanded during the past year. The experiments at Crowley, La., are being continued on a much larger and more suitable experiment farm. A new series of experiments has been inaugurated at that place and at Jacksonboro, S. C., Lonoke, Ark., Beaumont, Tex., Biggs, Cal., and the Arlington Experimental Farm, in Virginia. Two trained field agents have been employed to assist in this work.

In South Carolina the experiments are primarily for the purpose of determining the resistance of all varieties of rice to the disease known as rice blast, selecting and breeding for resistance to this disease, and ascertaining how different methods of cultivation, including irrigation and drainage, affect the control of rice blast. At the other points extensive variety tests have been inaugurated with the view of securing earlier maturing and higher yielding varieties, as well as varieties that can be successfully grown without irrigation.

CEREAL RUSTS, SMUTS, AND OTHER DISEASES.—The cereal-disease work has continued under the immediate charge of Mr. Edward C. Johnson, Pathologist. In the work on rusts the fact has been established by careful inoculation work that rust is one of the principal causes of "spikelet sterility" of wheat in the region around San Antonio, Tex.

Considerable attention is being given to the breeding of rust-resistant wheats. At the Minnesota Agricultural Experiment Station a "disease plat" is maintained, where the second generations of numerous hybrids between durums and hard spring wheats have been grown in 1909 and subjected to a severe rust test. The aim is to secure the rust resistance of some of the durums combined with the grain of a hard spring wheat suitable for general purposes. Some promising strains have been selected for future trials.

Work on the loose smuts of barley and wheat has been continued and a bulletin on the subject has been published. Further efforts are being made to develop a simpler treatment than the modified hot-water treatment at present recommended. The head smut of sorghums is being investigated at Amarillo, Tex., and the value of the modified hot-water treatment for this smut will this year be fully investigated.

The "blade blight" of oats, which has become a serious disease, is being investigated, and as the causes are not known with certainty numerous bacterial cultures from diseased plants have been secured and inoculations made on healthy plants.

The possibility of wheat scab being transmitted through the seed has been investigated, and the results show that although a badly scabbed kernel may not germinate or may produce a stunted plant, the heads of the plants which mature are not necessarily scabbed.

OAT INVESTIGATIONS.—The work with oats, conducted by Mr. C. W. Warburton, Agronomist, has been largely along the lines of selection and breeding. A large number of oat hybrids made in previous years were grown at Bloomington, Ill., and further selections were made for yield, strength of straw, earliness, and other desirable characteristics. Pedigreed selections of a number of standard varieties were also grown for comparison with the hybrids and with unselected stocks. About fifty of the most promising strains, including both straight selections and hybrids, were sent to the experiment stations in a number of the leading oat-producing States for testing. Preliminary trials indicate that some of these strains will be of considerable value over a wide range of territory. The most promising stocks are included in the selections of Sixty-Day and Burt and the hybrids between Sixty-Day and Burt, Sixty-Day and Clydesdale, and Clydesdale and Rustproof.

Extension work was continued with Burt, Sixty-Day, and Swedish Select. The first of these varieties is now generally considered the best spring oat for North Carolina, Tennessee, and States with similar climatic conditions, and the area of its growth is extending northward. Sixty-Day and Kherson, by many considered identical, have for several years given the highest yields in the corn belt, and the Swedish Select is a leading variety in Wisconsin, North Dakota, South Dakota, and Montana. Both the Sixty-Day and the Swedish Select varieties were introduced by the Department of Agriculture. Extensive breeding work with winter oats has been carried on at the Arlington Experimental Farm and in cooperation with some of the southern experiment stations, and some interesting results have been secured.

BARLEY INVESTIGATIONS.—The work with barleys, in charge of Mr. H. B. Derr, Agronomist, has included breeding, variety testing, and the distribution of seed, the latter phase being confined to winter varieties and those of the beardless and hull-less types. In the breeding of barleys several new forms have been produced, the most important being a strain of Tennessee Winter without awns. This is a valuable improvement, as the awns have always been objectionable. This barley will be increased as rapidly as possible. Several beardless and hull-less barley hybrids which seem promising have also been developed. Investigations are being made of the adaptation of beardless and hull-less barleys. These varieties were at first used exclusively for hay purposes, but strains have been developed that mature their grain at high altitudes where other grain crops are generally unsuccessful.

Three varieties of winter barleys were selected for purity of type last year and increased this season, yielding several bushels of excellent seed, part of which will be distributed to reliable cooperators the coming fall. A large number of winter varieties were tested and several excellent ones secured. A new feature of the work with winter barley is its introduction into the semiarid regions. Under conditions where spring barley fails, owing to lack of moisture, it has been found that winter barley can frequently be successfully grown. This feature of the work will be further developed.

Cereal work planned for the ensuing year.—As many of the investigations now under way require considerable time for completion, the work for the coming year will be largely a continuation along present lines. Special emphasis will be placed upon the development of hardy varieties of winter barley, oats, and durum wheat and upon the production of distinct pure strains of the latter. The work in the adaptation of cereals to high altitudes will be continued, and the most favorable dates and rates of seeding in the dry-land areas will continue to be studied. Demonstration work with winter emmers, the extension of the winter-wheat area, and related lines will be continued. An investigation of the possibility of rice cultivation in California will be made. The work on cereal diseases will be conducted along the same general lines as heretofore.

CORN INVESTIGATIONS.

The investigations of the Bureau with special reference to the most profitable methods of corn production and improvement have continued in charge of Mr. C. P. Hartley, Physiologist.

Study of cultural methods.—The results of several years' work have demonstrated the impossibility of outlining a method of culture that will give the highest possible yield of corn per acre during all seasons. During the dry season of the past year the average results in a number of tests show a gain of 4.66 bushels per acre by planting corn 5 or 6 inches below the general level of the ground. Of 48 tests of low planting and surface planting, 36 tests produced best by low planting and 12 by level planting. For sections subject to dry weather during July and August low planting is advisable. The furrows in which the young plants are growing should not be filled so as to level the ground until the root system of the plants is well established. The advantage of sod ground for corn, and especially clover or alfalfa sod, has been forcibly demonstrated in different localities during the past year.

Williamson method of corn culture.—Of recent years much interest has been manifested in the method of corn culture known as the Williamson method. This system is too complex—that is, contains too many distinct principles of corn culture—to be as a whole either condemned or recommended. Many who have tried it now favor it because their yields have been increased by its adoption. All of the different principles which the method embraces are being experimentally tested. The results thus far obtained show that judicious modifications of the method to insure greater conservation of moisture or other requirements of vigorous plant growth produce in some seasons further increase in yield.

Commercial fertilizers for corn.—The unusually high price of corn has resulted in a more extensive use of commercial fertilizers. Recent experiments favor the application of fertilizers several weeks after the corn has been planted. When applied at planting time, especially if heavy applications of high-grade fertilizers are made, the fertilizer should be drilled or broadcasted in preference to placing it in or on the hills. Seed corn of perfect germination has been killed by applying in the hills fertilizer at the rate of 350 pounds to the acre.

Corn investigations in Texas.—During the past year United States selection 137 was grown on a small area of Red River bottom land at Denison, Tex., with satisfactory results, the corn proving to be well adapted to that section. The same variety is being grown by a number of farmers in the vicinity of Denison and has carried off a number of premiums at the fairs and corn exhibitions. A cooperative test was also made of several of the Department selections of sweet corn, Black Mexican, Crosby, Country Gentleman, and Early Evergreen. The Black Mexican and the Crosby were too small and unproductive, and the period of edibility was too short to make them of value for Texas conditions. The Country Gentleman and the Early Evergreen yielded well and were satisfactory in other respects, although somewhat damaged, as is practically all corn in that region, by ear-worms. These and other varieties of the large and later maturing types of sweet corn can be grown to advantage for home and market garden purposes, and the more general cultivation of this type of corn is being encouraged. Similar work has been conducted at Waco, Tex., with good results.

At San Antonio and Camp Verde variety tests of 60 different strains of corn were made. At San Antonio the yield ranged from 26 to 60 bushels per acre. The highest yielder was a mixed type of white corn from Denison. Selection 136, from Waco, ranked second in yield, with a rate of 56 bushels per acre. At Camp Verde the range of yield was from 26 to 44 bushels per acre, a white variety from Terrell, Tex., being the highest yielder. Selection 136, from Waco, was again second in yield, with a rate of 42 bushels per acre. Other varieties of the same type as selection 136 were among the highest producers, both at San Antonio and at Camp Verde. Similar experiments have been under way at Marshall, Tex.

Corn investigations in irrigated sections.—The work of the past year in introducing and further improving and acclimatizing strains of corn for arid sections has been highly satisfactory. Although irrigated land can usually be used for truck crops and fruit more profitably than for corn, the recent reclamation by irrigation of large areas has greatly increased the interest in growing corn under irrigation. Difficulties of transportation and marketing and in scarcity of labor, so essential in connection with truck gardening, have caused more attention to be turned to corn growing. The urgent need for feed for work horses has also stimulated interest in corn. In some sections corn is grown as a second crop on irrigated land that has produced early spring crops.

In many instances the attempts at corn growing in newly settled localities and under irrigation are failures because the same kind of corn is planted that the settlers previously grew in Ohio, Illinois, or Iowa. The tests of this Bureau during the past four years at Yuma, Ariz., Chico, Cal., and Fallon, Nev., demonstrate that choice of variety alone often decides between success and failure. Strains introduced from foreign countries and local strains have under similar treatment varied in yields from nothing to fairly prolific yields of grain. Some of the most promising are being successfully bred for higher yielding power and further adaptation to conditions of drought and to hot winds. The use of such varieties on the reclamation projects and in the semiarid sections will prevent many of the failures now so common and discouraging in newly settled sections.

Value of corn-improvement work.—Marked increases in production have been made in some sections as a result of the work of this Bureau, and the investigations have yielded valuable knowledge, but on the whole it can be said that general corn-improvement work is but begun. The general interest of farmers of almost all States in this crop, its great value, and its immense possibilities warrant the expenditure of many times the amount that has proved so remarkably profitable. What has been done is only a demonstration of what could and should be done on a scale in proportion to the value of the crop—a value several times greater than that of any other crop our country produces. It is hoped that the demonstrations of the profitableness of breeding higher yielding strains of corn that have so greatly benefited the farmers in sections in which the work has been conducted can be carried into new districts and thus reach a larger proportion of our farmers.

ACCLIMATIZATION AND ADAPTATION OF CORN, COTTON, AND OTHER CROPS.

The investigations of the Bureau directed toward the acclimatization and adaptation of varieties of corn, cotton, and other crops introduced from tropical countries have continued under the general supervision of Mr. O. F. Cook, Bionomist, assisted by Mr. G. N. Collins. The field experiments in the acclimatization of new varieties of cotton have been conducted by Messrs. F. L. Lewton and Argyle McLachlan, while studies of corn varieties in tropical America have been made by Prof. H. Pittier. Particular attention is being given to the adaptive characters, environmental reactions, and methods of breeding of varieties of corn and cotton, in order to improve these crops, to give them increased protection against insect enemies, and to extend the range of their cultivation. The investigations in the breeding of cotton for boll-weevil districts, which are now affiliated with this work, have been conducted under the general supervision of Dr. D. N. Shoemaker, Expert.

SPECIAL WORK ON CORN.

The study of new varieties of corn has been continued, several additional kinds having been received during the year through the Office of Foreign Seed and Plant Introduction.

Adaptive characters of new varieties.—Many of the new varieties received prove to have special characters that adapt them to particular conditions and furnish valuable material for breeding. Of special interest is a variety from Shanghai, China, in which the silks of the young ear are protected by the base of the leaf. The leaf blade is held in a nearly vertical position and the base partly encircles the stalk, forming a somewhat funnel-like recess that collects a supply of pollen. The silks are pushed up into this sheltered receptacle of pollen and become fertilized without being exposed to the wind. The drying of the silks by exposure to hot winds often prevents pollination in other varieties of corn and is one of the most serious obstacles to the cultivation of corn in arid regions.

Increased yield from crossing varieties of corn.—Experiments have shown that the yield from crosses of two varieties or strains of corn is in almost every case materially larger than that of the parents. It has been pointed out in a publication that this method of increasing the yield can be utilized in farm practice by the simple expedient of planting the strains or varieties that are to be crossed in alternation and then removing the tassels from all of the plants of one of the varieties. All the seed produced by the plants of the detasseled rows will be cross-pollinated and can be used for the planting of the general crop in the next season. Experiments are now being conducted with a view to a more thorough understanding and demonstration of the importance of this factor in different varieties of corn.

Value of broad breeding in corn.—It has been found necessary to issue a word of warning against the danger of too close breeding in corn and to show that the practice of attempting to remove the “ barren ” stalks from cornfields before the pollen is shed is of altogether doubtful value, though often recommended by writers on the breeding of corn. Our studies of primitive varieties of corn show that the production of pollen naturally precedes the silking and is in the nature of an adaptive specialization that protects the plants from self-fertilization. Plants with the stalks still “ barren ” when the tassels mature often show themselves very prolific before the end of the season. The elimination of such stalks should be confined to localities with very short seasons. The removal of the proterandrous plants—those that produce their pollen early—increases the percentage of self-pollinated grain and tends to prevent the increase of the yield by cross-pollination. Emphasis should be laid on the elimination of weak or unproductive plants rather than of those that produce the pollen in advance of the silks.

Results of composite breeding of corn.—The composite breeding of corn, as described in the last report, has resulted in the production in Texas of a vigorous and productive strain that appears to be well adapted to the local conditions and worthy of being tested in regular plantings.

COTTON BREEDING AND ACCLIMATIZATION.

Experiments have been continued with several new types of cotton introduced from Mexico and Central America because of their weevil-resisting characters and other desirable features, such as large bolls and long lint. In all of the imported types that belong to the Upland series definite progress is being made toward acclimatization. Even in types that remained completely barren in many of the earlier plantings the later generations are attaining normal characters and fertility. It is now becoming possible to apply the ordinary methods of selective breeding to obtain uniform strains suitable for commercial planting. Some of these strains are now being tested in comparison with our best Upland stocks.

Weevil-resistant varieties of cotton.—Continued study of new types of cotton from Central America has shown that some of them have very distinct advantages over our present Upland cottons with respect to weevil resistance. The proportion of the bolls that escape weevil injury has been found to be very much greater on the imported cottons under conditions of very heavy infestation of weevils. The most important of the weevil-resisting characters is the habit of growth found in the Kekchi cotton of Guatemala and other related types. The lower fruiting branches are not determinate, but continue the production of buds and bolls close to the ground, where they are comparatively safe from the weevils, owing to the strong instinctive tendency of the insects to climb to the top of the plant.

Mexican big-boll cottons.—Apart from the question of weevil resistance the most promising of the new Upland types thus far imported from tropical countries are Mexican cottons with the very desirable combination of large bolls and long lint: that is, larger bolls and longer lint than are combined in any of the Upland cottons now grown in the United States. The varieties with the largest bolls are not yet fully acclimatized, so that their cultural qualities remain in doubt, but a very satisfactory uniform strain has appeared in another variety, and this is being tested in regular field plantings.

Local adjustment of cotton varieties.—Experiments in local adjustment have been continued and a report has been published showing the practical importance of the local adjustment of cotton varieties as a ready means of improving both the yield and the quality of the fiber. Even the best and most uniform varieties of cotton are likely to show pronounced individual variations when grown under new conditions, and unless these variations are removed by continued selection the deterioration of the stock is inevitable. The problem of local adjustment is different from that of the improvement of varieties, since its object is not to change the variety, but to restore and preserve its uniformity. Neglect of this factor is responsible for enormous direct losses in efficiency or production, and also interferes seriously with the testing and introduction of superior new varieties. Experiments have shown that the testing of a variety by plantings for single seasons, without attention to local adjustment, is not likely to give any adequate indication of the value of a new variety in a new locality.

DETERIORATION OF COTTON THROUGH REVERSION.—Experiments with cotton hybrids have given indications of the nature of many of the variations that interfere with the improvement of cotton varieties by crossing and hybridization. In a series of cotton hybrids it often happens that a large proportion of the plants bring into expression characters of remote ancestors instead of those of the parent varieties. Thus, hybrids between smooth-seeded cottons generally gave fuzzy seeds, and the fuzz of the seeds of hybrids is usually green even when the parent stocks have white fuzz. Instead of combining the desirable characters of two large-bolled parent varieties, hybrids may seriously deteriorate from the parental standards by returning to a primitive condition of very small bolls. The rejection of these small-bolled reversions by continued selection is one of the factors of local adjustment.

DIVERSITY IN EGYPTIAN COTTON.—The knowledge and experience gained in the acclimatization and breeding of weevil-resisting Central American types of cotton in Texas are also being applied in the acclimatization of Egyptian cotton in Arizona, in cooperation with other offices of this Bureau. Several factors or forms of diversity have been discovered and described in a detailed report. Insects that cross-fertilize the flowers of cotton are unusually numerous and active in Arizona and are responsible for extensive hybridizing of Egyptian cotton with Upland cotton grown in the same localities, though definite indications of hybridization were also traced in plantings of imported seed. Other kinds of diversity appear to be due to incomplete acclimatization, many plants growing to abnormal size and remaining more or less completely sterile, as among the newly imported Central American cottons. Differences of external conditions are also able to affect the characteristics of the lint and even to alter its quality on different parts of the same plant. These facts show that the establishment of a satisfactory degree of uniformity in the Egyptian cotton will depend upon the solution of problems of culture and irrigation, as well as upon the continued selection and careful isolation of superior stocks.

ORIGIN OF THE HINDI COTTON.—The so-called "Hindi" cotton is one of the important factors of diversity of the Egyptian type. Plantings of newly imported seed that have had no opportunity to become hybridized with United States Upland varieties nevertheless produce many variant plants that show some of the characters of our Upland cotton. Previous study of the native varieties of southern Mexico and Central America makes it possible to identify the Hindi cotton as a member of the same general series of varieties. It shares many of the characters of our Upland varieties, but there are definite differences in the form of the calyx and other details of structure which render the two series distinct and show that the alliance of the Hindi cotton is with the tropical types rather than with our Upland varieties. As it does not appear that these American relatives of the Hindi cotton have been cultivated in Egypt or India, the possibility has to be considered that the Hindi contamination is very long standing and is kept alive by reversion, like the small-bolled variations that appear in other types of cotton even after long periods of breeding.

SUPPRESSED AND INTENSIFIED CHARACTERS IN COTTON HYBRIDS.—Though the frequency of reversion appears to preclude any general utilization of hybrid varieties of cotton, some experiments show a remarkable and entirely unexpected regularity in the expression of some of the characters. It has been found that the range of expression of the characters in the hybrids is not limited by the usual standards of the parent varieties, but may exceed or fall far below that of either of the parents. Moreover, this extreme behavior of the characters sometimes has a notable regularity through a whole series of hybrids. A bulletin has been published on this subject, describing numerous instances of suppression and intensification of characters in cotton hybrids, including the superior length and strength of the lint of hybrids of Egyptian cotton, which generally excelled the Egyptian parent in the season of 1908. The facts of suppression and intensification indicate new possibilities in the utilization of hybrids. Although the regular examples of suppression and intensification appear to be confined to the first generation of the hybrids, it may still be possible to make use of intensified hybrids in crops where hybrid seed can be secured in sufficient quantities. Further experiments are being made to learn whether this is possible in cotton.

BREEDING OF COTTONS FOR SOUTH CAROLINA.—In the general cotton-breeding work Mr. E. B. Boykin has been devoting his time during the past year in South Carolina to the selection of varieties already under test and also to the encouragement of breeding experiments by the farmers themselves. In the first line, the object is to obtain greater earliness and productiveness in short-staple Upland cottons. One of the varieties secured, called the Sistrunk, was distributed this year. The long-staple varieties Columbia and Keenan are also being further selected. The propaganda work with farmers has been instrumental in inducing many farmers to undertake the selection of their own cotton, and the work of the Department is thus being brought to the attention of the most progressive farmers in South Carolina.

COTTON WORK IN TENNESSEE AND ARKANSAS.—Prof. S. M. Bain has been engaged in the selection of early, productive, short-staple varieties of cotton for Tennessee and Arkansas. Trice, an early variety originated in this work, was distributed in Tennessee last year. Tests are in progress to determine the amount of crossing which normally occurs under Tennessee conditions. A series of observations on blooming periods in their relation to earliness for progeny-row tests is also being made. It is believed that the results of this work will soon be ready for publication.

BREEDING OF COTTONS IN TEXAS.—Prof. D. A. Saunders has been engaged in selection work in Texas with reference to boll-weevil conditions and also to the extension of cotton growing farther into the Panhandle region of Texas and Oklahoma. The most valuable varieties secured are various crosses of Upland types for the purpose of obtaining an early, big-bolled kind for the Texas black lands. Some early, medium-bolled sorts which are proving of value under Red River Valley conditions have also been developed. By far the most acute weevil infestation at present is in the moist river valleys of Louisiana and Mississippi. It is not yet certain that it will be possible to breed a long-staple Upland cotton sufficiently early for Louisiana conditions, but some of the small and medium bolled varieties are giving promise of proving of value. Professor Saunders has a long-staple early variety which he hopes may be available for these regions in the presence of the weevil.

In the Panhandle of Texas the problem is to secure a variety which will open sufficiently early to escape frost injury. This question is slightly different from that of securing the kind of earliness needed in boll-weevil regions. In eastern Texas work is being conducted in the selection of cottons for improved characters. Surprisingly good results have been secured, among which is a long-linted and very early selection, the commercial possibilities of which should be demonstrated by this year's tests.

SPECIAL PROBLEMS IN PLANT BREEDING AND ADAPTATION.

In connection with acclimatization and adaptation work with corn and cotton, various related problems have been studied, extending from the methods of plant breeding to the investigation of the native vegetation in tropical and subtropical America in its relation to agricultural economy.

Superiority of line breeding.—A study of the general biological relations of the principal methods of breeding has been completed and the results published in a bulletin. The usual classification into inbreeding and cross-breeding is shown to be inadequate and is replaced by a recognition of three primary types of organic reproduction, viz, broad breeding, narrow breeding, and line breeding. The superiority of strict line breeding over the more indiscriminate systems of narrow breeding is pointed out, and also the close physiological relation of other forms of line breeding to vegetative propagation. After appreciating the differences between line breeding and narrow breeding it is possible to understand that both of these systems are different from the normal condition of broad breeding, the normal system of reproduction found in all natural species of higher plants and animals. The practical conclusion is that breeders ought not to expect that the same general principle can be applied to all kinds of plants and animals. The various types of plant and animal life are as essentially different in their relation to line breeding as in their powers of vegetative propagation.

"New-place effects" in breeding.—Further experience with the abnormal vigor and sterility of tropical varieties of cotton and corn when planted for the first time in the United States shows that the stimulation of growth by new conditions occurs with regularity and is worthy of being utilized for increasing the yields of forage and other products secured from the vegetative parts of plants. It has usually been taken for granted that the tropical varieties are normally larger than those from temperate regions, but in reality many of them are no larger in their own native conditions than our northern varieties. The abnormal size attained in the United States is often due altogether to the change of environment and disappears with acclimatization. The increase of the vegetative development through "new-place effects" in corn appears to be somewhat less than in cotton, but plants raised from imported seed are often twice or three times as large as those in adjoining rows representing United States varieties. Imported varieties that are to be used in this way are not to be acclimatized in the regions where the crop is to be grown, but in other regions where seed can be grown that will bring the new-place reactions.

VEGETATION AFFECTED BY AGRICULTURE IN CENTRAL AMERICA.—Study of the natural conditions where desirable types of cotton and corn have developed in Central America shows that the native vegetation has been profoundly affected by the native agriculture, and a bulletin reporting these facts has been published. The present limitations of the forests and the wide extension of the open grass lands and cactus deserts are results of human activity. The repeated cutting and burning of the forests is followed by denudation and erosion of the soil and eventually induces a complete change in the character of the vegetation. Plants that resist fire and drought gain possession of the land, even in localities that still receive rainfall sufficient for the growth of forests. Former agricultural occupation of extensive regions that are now barren and uninhabited is proved by abundance of ancient remains, such as the agricultural terraces that cover large areas. There are also many facts of botany and zoology to show that most of the Central American forests are not virgin growth, but represent the reforestation of lands previously cultivated and abandoned.

VEGETATION OF THE SOUTH TEXAS PRAIRIES.—A circular has also been published showing the influence in Texas of the same factors that control the extension of the natural vegetation in Central America. The former treeless condition of the South Texas prairies is not to be explained by the natural conditions of climate and soil, but is a result of fire and human activity. The prevention of severe fires by regular grazing and the annual burning of the dead grass has permitted a very rapid extension of woody vegetation over wide areas in South Texas which were open grass lands only a few decades ago. This change of vegetation is rapidly restricting the grazing industry, with the result that the large ranches are being subdivided, sold to farmers, and placed under cultivation. The area of cotton production, in particular, is being rapidly extended, the relatively dry climate of South Texas affording an important factor of protection against the boll weevil.

SUGAR-BEET INVESTIGATIONS.

The work of the Bureau on sugar beets has continued in charge of Dr. C. O. Townsend, Pathologist. In addition to these investigations, Doctor Townsend is engaged in the study of various pathological problems in conjunction with the Laboratory of Plant Pathology, this work being described under that laboratory.

DISEASES OF SUGAR BEETS.—Several diseases of the sugar beet have continued to receive special attention during the past year, notably the curly-top, leaf-spot, and root-rot. A number of other diseases which have not yet become of commercial importance are under investigation. It has been definitely established that the so-called "curly-top disease" of the sugar beet is due to an insect, *Eutettix* *tenella*, commonly known as the "white fly." Methods for the control and prevention of this pest are now under investigation in cooperation with the Bureau of Entomology and the Utah Agricultural Experiment Station.

With reference to the leaf-spot produced by the fungus *Cercospora beticola*, investigations have been under way for several years with a view to determining the possibility of controlling this disease on a commercial scale. As previously reported, it was found several years ago that Bordeaux mixture would control this disease if properly applied. During the past two years it has been proved that the disease can be controlled on a commercial scale by actual field tests, and a special publication is now in preparation along this line. The root-rot may be controlled, as previously reported, by the use of air-slaked lime. In this connection the proper rotation of crops is a very important factor and should not be overlooked.

Special strains of sugar-beet seeds.—Work is still in progress in connection with the development of single-germ beet seed. It has been determined definitely during the past year that when a plant has once acquired the single-germ tendency, it is immaterial whether the seeds used in the propagation of this plant be single or multiple germ seeds, so far as the production of single-germ seeds is concerned. The development of the single-germ seed is now in progress in several stations, with fair prospects of ultimate success.

Efforts to improve the sugar beet in such manner as to increase the yield of sugar per acre by increasing the yield of roots or their sugar content, or both, have been continued, with interesting results. A circular showing the results of five years' tests in which the American seed is compared with the leading varieties of imported seed has been issued. It is worthy of note that these tests show that the American-grown seed is second to none, and considering the short time that the work has been under way in this country the outlook for producing all of our own beet seed of high grade is very flattering.

Sugar-beet extension.—There has been considerable demand during the last several years for information regarding the possibility of sugar-beet growing on a commercial scale in various sections of the country where the crop is not grown at present and where a greater diversification of farming is desired. So far as possible the sections from which these demands have come have been taken up and an endeavor made to determine their fitness for sugar-beet growing by actually growing sugar beets and making the necessary tests for sugar and purity. Hundreds of samples are grown and analyzed each season for this purpose, and valuable information has been obtained.

Cultural methods.—The experiments in determining the best cultural methods used in growing sugar beets are still in progress. Some interesting results have been obtained with reference to width of row, time and depth of cultivation, etc. It has seemed advisable to conduct these experiments for a number of years before attempting to draw any definite conclusions, in order to eliminate climatic effects as far as possible. Experiments with fertilizers and crop rotations in connection with sugar beets are also being conducted.

TOBACCO INVESTIGATIONS.

The tobacco investigations during the past year have included work with practically all the important commercial types produced in the country and have dealt with improved methods of growing, curing, and handling this crop, including fertilizer and crop-rotation experiments, breeding and seed selection, laboratory studies on the quality as affected by composition, and methods of combating important diseases. These investigations are now under the general supervision of Dr. W. W. Garner, Physiologist.

Tobacco is distinctively a money crop, in some cases representing a very intensive system of farming, and the industry is a highly specialized one; hence there is a constant tendency to push the growing of this crop into new territory. This tendency has been all the more marked during the past few years because of the healthy growth of sentiment in favor of diversification and rotation of crops. On the other hand, the danger of overproduction is a constant menace to the grower, and there is no doubt that the tobacco-growing sections in which the industry is already permanently established are capable of producing this crop in quantities more than sufficient to meet all legitimate demands. In view of these facts, any further decided extension of the industry must necessarily lead to further shrinkage in the profits derived from growing the crop, which are now, in most cases, far from satisfactory. It seems desirable, therefore, that our efforts be directed toward devising methods of growing more and better tobacco on a reduced acreage in the recognized tobacco belts and encouraging in this connection, wherever possible, systems of cover cropping and rotation and such other features of approved farming as will maintain adequate yields and keep down the many destructive diseases of tobacco incident to the one-crop system.

Roughly speaking, the important tobacco-producing districts may be grouped into the northern and southern cigar-tobacco areas, separated by the broad export and manufacturing tobacco area. The following outline gives a brief summary of the more important results obtained during the past year in the various tobacco districts.

INVESTIGATIONS IN EXPORT AND MANUFACTURING TOBACCO DISTRICTS.

Export and manufacturing tobacco includes all types other than those used for the making of cigars, and there are naturally some important differences between the types produced in the different districts. During the past year experiments have been conducted by Mr. E. H. Mathewson, Crop Technologist, in the States of Virginia, Maryland, North Carolina, and Kentucky. The plan of work in each of these States is fundamentally the same, but with sufficient modification in different localities to adapt it to the type of tobacco produced and to the peculiarities of soil. Recognition is taken of the fact that the soil areas in most of the tobacco sections of these States have been hard worked with humus-depleting and exhaustive crops, principally tobacco, corn, wheat, and oats, with inadequate attention to the production of legumes and grasses and to live-stock husbandry. The following are the three principal features of the work in each of the States:

Fertilizer experiments.—The experiments with fertilizers are conducted by means of test plats, in series, repeated on a variety of soils year after year, the results obtained being checked finally by tests on larger areas under ordinary field conditions. The results obtained from the three years' work already completed in Virginia show conclusively that there is great room for improvement in the profitable use of fertilizers. These tests repeated for a number of years and on a variety of soils in different localities can not fail to lead to a more intelligent use of fertilizers, not only for tobacco but for other crops as well.

Crop-rotation experiments.—This feature of the work is fundamental in nature and is so arranged as to bring out the best way of combining the growing of the soil-improving legumes and grasses with the exhaustive and humus-depleting crops, such as oats, wheat, corn, and tobacco. Not only will this lead to greater diversification of interests, greater attention to soil-improving crops, and increased interest in stock raising, but it is only when taken in connection with this feature that the fertilizer work becomes of greatest value. The results already obtained bear striking testimony to the value of this work.

Variety tests.—Along with the other phases of the work, an effort is being made to improve the tobacco crop by trying out the standard varieties by the row-to-row method in order to determine their comparative usefulness, and each year careful selection is made of the best plants for the purpose of improving the varieties in yield and quality. Many of the farmers are using seed of our breeding for their entire crop.

In selecting locations for this work preference is always given to one as public as possible on an important highway, preferably near the county seat or a good farming center of trade, in order that as many farmers as possible may see the work and derive benefit from it. The plats and experiments are plainly marked and the attendant in charge is ready to explain any points or to assist farmers in putting into practice on their own farms the better methods developed.

Cooperation with the state authorities.—All of the work in the States named is conducted in cooperation with the state experiment stations, each bearing a portion of the expense of the work, except in North Carolina, where the work is in cooperation with the state department of agriculture. In Virginia the State has made a special appropriation of $5,000 in support of the work, which has consequently been considerably extended so as to include two stations in the dark-fired tobacco belt, at Appomattox and Rustburg; two in the flue-cured belt, at Chatham and Axton; two in the sun-cured belt, at Bowling Green and Louisa; and one in the black or olive-green stemming district, at Fork Union. In Maryland most of the work is located at Upper Marlboro, with subsidiary centers at Lyons Creek and La Plata. The scope of the investigations at Upper Marlboro has been materially expanded the past year, the State having considerably increased its allotment for the work. The experiments in North Carolina, located at Greensville, in Pitt County, have just been started and no report can as yet be made on their progress.

In Kentucky the work, which has heretofore consisted almost entirely of breeding and seed selection, has been broadened so as to include fertilizer and crop-rotation experiments, with locations at the state experiment station at Lexington, in the Burley district; at Hopkinsville, in the dark-fired district; and at Hardinsburg, in the Green River district.

It is planned to continue the investigations during the coming year in these States along the lines mentioned. Work of this kind shows most convincing results only when carried out uninterruptedly for a number of years, and the experiments will necessarily have an ever-increasing value from year to year.

INVESTIGATIONS IN NORTHERN CIGAR-TOBACCO DISTRICTS.

During the year just ended investigations have been conducted in the States of Massachusetts, Connecticut, Ohio, and New York, and in all of these except the last named the work is in cooperation with the state experiment stations. This work consists essentially of experiments and demonstrations in improved methods of breeding and seed selection, growing, curing, and handling the crop.

WORK IN CONNECTICUT AND MASSACHUSETTS.—The most important feature of the work in these two States has been the testing of the commercial value of the Halladay Havana tobacco and its further improvement by row tests of the best individual selections. This type was originated from a cross of Sumatra and Connecticut Havana and is especially promising because of the fact that it far exceeds the ordinary Havana Seedleaf in yield when grown under similar conditions. This tobacco yields from 25 to 28 good leaves per plant and presents an extremely handsome appearance in the field. If the tests now being made on a commercial scale further substantiate the results already obtained, this promises to be a very valuable type for wrapper and binder purposes, especially adapted to curing by the priming method. A number of growers in the Connecticut Valley are cooperating with the Bureau in giving this tobacco a thorough trial.

The value of the method of sterilizing seed beds with steam, devised by this Bureau, was demonstrated in a striking manner this past season. Those growers who used this method secured an abundance of healthy plants, while there was in general a great scarcity of plants suitable for transplanting at the most favorable season. This sterilization of the soil effectually destroys tobacco root-rot and other fungous diseases, as well as all weed seeds.

WORK IN NEW YORK.—The work in New York includes breeding and seed selection, experiments with winter cover crops, and methods of fermentation, but the most important feature is fertilizer tests conducted in cooperation with growers for the purpose of determining the best usage of commercial fertilizers for maintaining and improving the yield and quality of the crop. Formerly the use of improper forms of fertilizer in growing tobacco injured the quality to such an extent that dealers refused to handle crops grown with the aid of commercial fertilizers in any form, with the result that the growers have relied solely on stable manure obtained principally from New York City. Recently this supply of manure has failed, causing an urgent demand for other sources of fertilizing materials, and the efforts of this Bureau are being directed mainly toward demonstrating that the direct demands of the crop for plant food can be largely met by the use of commercial fertilizers when the correct formulas are used, and not only without injuring but actually improving the quality of the product. Through the results of this work the leaf dealers have recently rescinded their action in refusing to handle tobacco grown with commercial fertilizers. Increased interest is being shown by the growers in the use of Russian hairy vetch as a winter cover crop for their tobacco lands.

Work in Ohio.—Under the plan of cooperation with the Ohio Agricultural Experiment Station the handling of the field work in connection with the investigations in breeding and seed selection and improved methods of growing and curing tobacco are left in the hands of the station, while the fermentation and testing of the samples and selections, including studies on nicotine content, are carried out in the tobacco laboratory of this Bureau. Several improved strains have been secured which give great promise of value for filler purposes with respect both to yield and to quality.

INVESTIGATIONS IN SOUTHERN CIGAR-TOBACCO DISTRICTS.

During the past year the work in the southern cigar-tobacco districts, comprising portions of Florida, Georgia, Alabama, and Texas, has been mainly of an advisory nature designed to assist growers in the best methods of growing and handling wrapper and filler tobaccos. In Alabama this work has been carried on in cooperation with the state department of agriculture and industries.

Work in Florida and Georgia.—In Gadsden and Leon counties, Florida, and Decatur County, Georgia, this Bureau has cooperated with the growers by furnishing them with a limited amount of seed secured last year from seed-breeding plats and by assisting them in making seed selections. Some valuable strains of tobacco which will assist in bringing about a more uniform type of leaf, which appears to be especially necessary at this time, have been obtained. A number of serious diseases, as well as insects, are rapidly gaining headway in this section and are causing great loss. Chief among these troubles are the Granville wilt, root-rot, the thrips, and the nematode.

It is planned to conduct a series of experiments next year in Gadsden County for the purpose of determining (1) to what extent tobacco wilt, root-rot, and other diseases can be controlled by fertilizer treatment combined with proper cultivation and handling of the soil and (2) the best system of fertilizing to improve the quality of the crop, with special reference to securing information as to the best form in which to supply potash for improving the burn without injuring the product. It is believed that this work, along with that of breeding a uniform type of acclimated Sumatra tobacco, will materially assist the growers in producing a more uniform product of higher quality.

Work in Alabama and Texas.—In accordance with the policy of this Bureau toward the extension of the tobacco industry into new territory, the work in Alabama and Texas has been confined to assisting the growers by furnishing them with acclimated Cuban and Sumatra seed selected from breeding plats last year and instructing them in the best methods of fertilizing, cultivating, harvesting, and curing cigar-leaf tobacco. In no case has there been any effort to boom the industry or to induce farmers to undertake the growing of this crop. It has been demonstrated that a superior quality of filler can be produced in certain sections of these States, but the future of the industry will depend on whether the trade will recognize this product as distinct from other domestic filler leaf and thereby give it a standing which will insure a satisfactory market.

In Texas $1,000 per annum for two years has been appropriated for the purpose of assisting this Bureau in the work in Nacogdoches County. It is planned to conduct a tobacco experiment farm at Nacogdoches for determining and demonstrating the best methods of fertilizing, cultivating, and curing filler tobacco and for improving further the quality and yield by breeding and selection.

LABORATORY INVESTIGATIONS.

The work of testing the merits of the selections made in the field in connection with the breeding work, fertilizer experiments, etc., more particularly of the cigar type, is carried out in the laboratory, where special facilities for the purpose are provided. In addition to these routine tests, investigations are carried on for determining the relation of the composition to the important qualities of the leaf and for devising means of improving these qualities.

Studies on curing.—The essential changes in composition effected by the curing process have been studied. The results of this work in connection with data already secured on the most favorable conditions of temperature, humidity, etc., for accomplishing these changes afford an excellent basis for improving the present methods of curing, including the use of appropriate measures to prevent the disease known as "pole-sweat." For this purpose experiments under practical curing conditions will be continued during the coming season in a barn at Suffield, Conn., which has been equipped with special facilities for heating and ventilating.

Aroma of tobacco.—Experiments have been continued with very promising results for the purpose of determining the best practical method of treating cigar tobacco with citric acid with a view to removing the biting, irritating property of smoke from much of our domestic filler. The study of the important changes in the composition of the leaf occurring during fermentation was completed and experiments in a practical way are being carried out with a petune, the formula of which is based on this work. This petune is designed to improve both the burn and the aroma of the tobacco, and the preliminary tests have given interesting and very promising results.

The problem of securing by breeding and selection strains of cigar-filler tobacco of fine flavor and aroma, but of mild quality, by reducing the nicotine content has been continued along the same lines as heretofore, with special reference to the merit of strains low in nicotine already secured by selection.

GENERAL PLANT-BREEDING AND PLANT-NUTRITION INVESTIGATIONS.

The miscellaneous plant-breeding projects, as well as the preliminary work on plant nutrition, have been placed in charge of Dr. W. W. Garner, Physiologist.

GENERAL PLANT BREEDING.

The work included under this head embraces asparagus breeding and cover-crop breeding, conducted by Mr. J. B. Norton, and cooperative plant-breeding demonstrations in the cottton belt, conducted by Mr. H. A. Allard. Following is a summarized statement of progress made in these lines during the past fiscal year.

Breeding rust-resistant asparagus.—The asparagus-breeding work, which is conducted at Concord, Mass., in cooperation with the Massachusetts Agricultural Experiment Station, has been enlarged during the past year and now promises excellent results. Over one hundred selections of male and female plants markedly resistant to rust have been made from a 2-acre field planted with the best varieties of this country and Europe. Most of these selections were carefully interbred by hand during the spring of 1909. This hand-fertilized seed will be used this fall to test the rust-resistance of the different combinations and also the quality and vigor of the seedling plants. About 5 acres of seedlings from the best two imported varieties have been planted this spring on the experimental farm. This area will give over 20,000 plants for selection this fall.

The early development of the rust this season has shown that the resistant plants of 1908 are again showing resistance this year. The methods of breeding and of testing seedlings have now been developed and placed on a working basis and definite results are only a question of time.

Cover-crop breeding work.—This work has special reference to the production of winter cover crops for tobacco lands. Tobacco is an exhaustive, humus-depleting crop, and because of the system of clean cultivation required it is especially desirable to secure some crop for covering the soil during the winter so as to avoid injury from washing and leaching, to preserve the humus supply, etc.

In the development of hairy vetch as a winter cover crop for tobacco lands the work has been retarded by the difficulties attending seed production. In this work different winter crops have been planted with the vetch to serve as a support for keeping it off the ground, rye having given the best results for this purpose. New methods of growing seed are being planned and developed. In this connection it has been necessary to devise a machine for separating the vetch seed from the rye or other grain grown with it, and a satisfactory device for this purpose has been constructed and put into operation in the Connecticut Valley, where this work is being conducted.

Gray winter oats were planted as a winter cover crop in Connecticut in the fall of 1906, and some of the plants have survived through each succeeding winter. There has been obtained in this way a strain of oats which has withstood three winters in the Connecticut Valley, and, while it is not perfectly hardy yet, it is hoped that the hardier strain will increase in the general stock until it will drive the less resistant strains out of the variety.

Cooperative plant-breeding demonstrations.—The plan of this work, which is at present confined to the Piedmont section of Georgia, is to cooperate with farmers having the necessary facilities by supplying advice and assistance in arranging breeding fields, making seed selections, and sowing and separating seed. In this work special attention is given to cotton, but an effort is made also to stimulate interest in the general improvement of crops by breeding and selection when properly conducted in connection with improved methods of cultivation, etc. The distinctive feature of the work is its educational aspect. Breeding in itself is only incidental and is limited to the requirements for proper demonstration of the practical benefits to be derived by the application of its principles.

The work was begun by assembling and testing all the standard varieties of cotton for the purpose of securing for further work those best adapted to the northern Georgia region. The superiority of some of the selected varieties over the ordinary unimproved cotton of the region has been demonstrated, and a number of the farmers are now growing these and carrying on the work of selection for their further improvement with the assistance of this Bureau. The success of this work has led many of the best farmers to extend the practice of making careful field selection of seed to their crops of corn, oats, wheat, etc. The best indication of its success is the enthusiasm and support shown by an influential farmer of this region, who has equipped his farm with a hand gin and a seed separator and does much of the seed separation and of the ginning of selections for the entire region. It is difficult to overestimate the value to a community of thus encouraging some of the most intelligent growers to conduct practical experiments in their own fields, giving them the necessary instruction and assistance in developing the ability to make judicious selections for the improvement of their crops.

During the past year a horticultural fair has been organized at Gainesville, in this section, and the first exhibit last fall was large and well attended. There will be another exhibit this year, and great interest is being shown by the farmers in endeavoring to secure material for this fair. This affords an invaluable means of acquainting the farmers generally with the results of the cooperative work of those who are improving their crops by intelligent breeding and seed selection combined with good systems of soil management.

PLANT-NUTRITION INVESTIGATIONS.

The primary object of the plant-nutrition investigations, in general terms, is to determine the most favorable nutritive ratios for specific crops, not only with reference to gross crop yields, but also with respect to the composition of the crops as regards their most valuable constituents. The work includes experiments to discover in how far the optimum nutritive ratios are essentially different for different crops; to secure further information on the rôle of certain mineral elements which are commonly regarded as not essential to plant growth but which may, in their interrelations with the nitrogen, potash, phosphorus, and calcium ordinarily applied as fertilizers, perform important functions in influencing the nutrition of the plant; to devise means of providing for the proper nutrition of special crops, as, for example, tobacco, in such a way as to avoid injury to the quality of the product by the absorption of deleterious substances; to study the interrelations between plant nutrition and resistance to parasitic disease with a view to discovering some chemico-physiological reaction as indicative of relative resistance, and to inquire into the effects produced by the different factors of nutrition on the development or suppression of the protective constituents of the plant; and to determine the relative influence of different nutrients on the production of specific constituents of crops, as, for example, the organic acids and nicotine of tobacco and the oil of cotton seed.

Scope of the investigations.—The various problems enumerated will in each case be dealt with from the standpoint of the particular crop in question, with a view to increasing the yield or to improving the quality and value by favoring the increased development of some one or more important constituents. The investigations will include physiological studies in the laboratory pertaining to nutrition and water and sand cultures, further supplemented by experiments under practical field conditions.

The two following field experiments are under way, and similar lines of work dealing in a practical way with some of the other problems already outlined will be started during the year:

Experiments with tobacco.—The problem here is to furnish to the plant the requisite quantity of potash to impart good burning qualities in such forms as to avoid the absorption of other elements or radicles (for example, Cl or SO_3) which would prove injurious to the quality of the product. A mixture of potash salts properly balanced, rather than a single form, as ordinarily used, is being tried as a means of accomplishing this purpose.

Experiments with cotton.—A series of experiments with fertilizers is being conducted in cooperation with the Office of Cotton-Breeding Investigations of this Bureau for the purpose of determining the most favorable nutritive ratio for cotton and of studying the relative influence of the different elements of plant food on the oil content of the seed.

INVESTIGATIONS AND EXPERIMENTS IN THE ARID AND SEMIARID REGIONS.

The Bureau has continued to develop those branches of its work which have to do with the upbuilding of agriculture in the newly settled areas of the semiarid West and Southwest. More than twenty distinct stations are now established throughout the Great Plains and intermountain districts, and the work at these stations is making excellent progress. All of the various offices of the Bureau which are dealing with dry-land agriculture problems are working in close cooperation, and a brief outline of their work during the past year follows:

DRY-LAND AGRICULTURE INVESTIGATIONS.

The investigations in dry-land agriculture in the Great Plains area, with Mr. E. C. Chilcott as Agriculturist in Charge, have progressed along substantially the same lines as those described in previous reports.

Many stations necessary.—The importance of having a large number of stations distributed over a wide area where the agricultural problems are similar at which thoroughly coordinated experiments can be carried on is becoming more conclusively demonstrated as the work progresses. Many valuable data are being accumulated concerning the agricultural problems in the Great Plains area upon which reliable conclusions can be based. Not the least important fact demonstrated is the danger of attempting to draw conclusions from observations, experience, or experiments carried on in a single locality. Local or seasonal weather and soil conditions are often the controlling factors in determining the success or failure of methods of tillage and crop rotation.

MOISTURE CONSERVATION NOT THE ONLY PROBLEM.—That phenomenal yields are sometimes obtained from certain tillage methods when soil and climatic conditions are favorable in the arid and semiarid districts has been demonstrated by interested parties to an extent that has brought profit to the exploiters but often ruin to the credulous home seeker. The fact that these methods often fail to produce good crops has, however, been carefully withheld from the public. Until these investigations were undertaken by the Office of Dry-Land Agriculture no adequate effort had been made to gather data showing the percentage of failures of these methods and the cause of these failures. Hail, high winds, frosts, and attacks of insects and disease are all factors of such importance in many parts of the Great Plains that they can not be safely neglected in a study of the agricultural problems of this area. There are undoubtedly localities where these factors are so important that it is very doubtful whether it is safe to recommend even the most approved methods of tillage for the conservation of moisture. These methods necessarily involve considerable additional expense without any additional safeguard against any of the dangers which threaten the crop except that of drought. All this additional expense increases the risk that the farmer takes, and if he fails his loss is proportionately greater than it would have been had he adopted a less expensive system.

MORE COOPERATION NEEDED.—In view of the situation just described, the problems which this office has set itself to solve are not alone the devising of the best methods of tillage and crop rotation for the development of a profitable and permanent agriculture under conditions of scanty rainfall, but a careful study of all the factors affecting crop production under these conditions will be necessary; and an analysis of the causes of failure or reduced yields other than lack of soil moisture will also have to be made, for the purpose of determining as nearly as may be the territorial limitations of safe agricultural operations and the best methods of utilizing the natural agricultural resources of this vast area. The cooperation of many other offices of this Bureau and of other bureaus has already been secured for this purpose, and this cooperation should be extended and developed. The data being rapidly accumulated at the thirteen stations already established in the Great Plains area will go far toward establishing a safe and sound basis for such study and analyses. Additional stations should be established as soon as possible.

TRAVELING FIELD ASSISTANTS.—Mr. John S. Cole, Field Assistant, with headquarters in Denver, spends nearly all of his time during the growing season in visiting the several stations and the adjacent country, and he is rendering valuable assistance in studying agricultural conditions and bringing the work of the farmers and the work of the stations into as close and helpful relations as possible. One or two additional assistants who could aid in this work are urgently needed.

New stations established.—Arrangements have been perfected for carrying on work at two new stations, both in connection with United States reclamation projects. One of these is located on the Huntley Irrigation Project, near Huntley, Mont., and the other on the North Platte Irrigation Project, near Scottsbluff, Nebr. At both of these stations the work of this office is to be conducted in close cooperation with the Office of Western Agricultural Extension of this Bureau and with the state experiment stations of Montana and Nebraska, respectively. Each of the thirteen stations now established is in immediate charge of a competent assistant, working under the direction of the Agriculturist in Charge and the traveling field assistant.

WESTERN AGRICULTURAL EXTENSION.

During the past year the Office of Western Agricultural Extension, under the direction of Mr. Carl S. Scofield, Agriculturist, has continued the operation of three field stations of the Bureau. Two of these stations, at Yuma, Ariz., and Fallon, Nev., are located on United States reclamation projects.

San Antonio, Tex., experiment farm.—At San Antonio, Tex., the season of 1908 was unusually favorable to crop growth, and excellent yields were obtained from the staple crops. The winter of 1908–9 was an unusually dry one, and so far the present season has been the driest during the period of record, extending over thirty years. This dry season has given an excellent test of the value of improved tillage methods. One field which had been kept fallow and well tilled for a year previous to the autumn of 1908 was then sown to trial plats of wheat and oats, and as a result of the previous tillage yielded fair crops of grain, while other fields that were given only ordinary treatment failed entirely.

Yuma, Ariz., experiment farm.—At Yuma, Ariz., the major portion of the work has been on Egyptian cotton, in cooperation with Mr. T. H. Kearney, of this Bureau. The results of this work are reported elsewhere. The experiments with eucalyptus, in cooperation with the Forest Service, have also been given considerable attention, and a large number of forage and horticultural crops have been under trial.

Fallon, Nev., experiment farm.—At Fallon, Nev., considerable attention has been given to the subjugation of the heavy soils through special tillage methods, to the trial of varieties of corn, forage, and horticultural crops, and to the planting of trees for wind-breaks and fuel. Good progress is being made with the work at this station.

New stations to be established.—During the ensuing year the work of this office will be extended to four additional reclamation projects, namely: Klamath and Umatilla, in Oregon; Huntley, in Montana; and Bellefourche, in South Dakota. These stations will be similar to those already established. At Umatilla the farm is to be conducted in cooperation with the Oregon Agricultural Experiment Station, the work being directed by that station. At Huntley the work is informally in cooperation with the Montana Agricultural Experiment Station. At Bellefourche the farm previously operated by the Office of Dry-Land Agriculture will be continued by this office. As has been the case with the field stations already established on reclamation projects, it will be the aim to provide facilities at these new stations for investigators of the Bureau of Plant Industry to work on local problems and make demonstrations of their results.

ALKALI AND DROUGHT RESISTANT PLANT BREEDING.

The work of breeding and testing crop plants which will resist alkali and drought has continued in charge of Mr. T. H. Kearney, Physiologist. Chief attention has been devoted during the past year to the acclimatization and adaptation of Egyptian cotton in the arid Southwest, but good progress has also been made on the other projects under way.

Egyptian cotton in the Southwest.—A dozen bales of fiber that compared favorably with imported Egyptian cotton in spinning tests made by manufacturers were produced in southern Arizona in 1908. Owing to the fact, however, that the strain developed at Yuma when planted at other localities in the Colorado River region showed considerable lack of uniformity in productiveness and quality of the fiber, it was decided not to make a general seed distribution in 1909. Instead, experimental plantings of several acres each were made at Yuma and Sacaton, Ariz., and in the Imperial Valley of California, and these are being kept under close observation in order to ascertain the causes of this diversity. For comparison, newly imported seed of the leading Egyptian varieties was planted at Yuma and Sacaton.

A 5-acre field was planted at Yuma with seed derived from the 1907 individual selection of which the progeny in 1908 showed the greatest uniformity in productiveness, desirable shape of plant, large size of bolls, and good quality of fiber. The plants in this field are remarkably uniform this season in shape, productiveness, and size of bolls. If the fiber is as uniformly good as was the case in 1908, and if this acclimatized strain maintains its uniformity and good qualities when planted at other localities in the region, it is believed that it will afford a satisfactory basis for extensive culture of a high-grade cotton of the Egyptian type. Most of the Egyptian varieties grown in Arizona this year from newly imported seed have shown themselves to be far from uniform, producing a considerable percentage of plants which are strikingly different from the type and are generally nearly sterile. This proves that Egyptian cotton as it exists in the home country is greatly in need of improvement by selection and increases our chances of rivaling the Egyptian product in the United States.

Alkali-resistant crops.—Certain forage plants, especially German millet, Amber sorghum, and a number of important meadow and pasture grasses, have shown themselves during several years of experiment to be decidedly resistant to alkali. Efforts are being made this season to ascertain the best tillage methods to be used in growing these and other more or less resistant plants on alkali land and to determine the effects upon the growth of these plants of applying manure, land plaster, etc., to such land.

INDICATOR VALUE OF NATIVE VEGETATION.—A study of the relation between the structure and physiology of the native plants and their environment is being carried on in order to obtain a scientific basis for the use of the natural plant covering as an indication of the suitability of different environments for different crop plants. In eastern Colorado correlations have already been worked out between the different types of native vegetation and the physical conditions of the environment which allow us to predict with considerable confidence what particular crop plants can be grown to best advantage on the areas covered with the different kinds of vegetation. It is believed that these results can be applied with little modification throughout the most arid part of the Great Plains region and will be of great service in agricultural surveys of the great tracts of land in that part of the country that still retain their covering of native plants.

DROUGHT-RESISTANT PLANT BREEDING.—At Bellefourche, S. Dak., strains of Amber sorghum, Kursk millet, and alfalfa developed from selections originally made in cooperation with the South Dakota Agricultural Experiment Station at its Highmore substation have shown themselves decidedly superior in hardiness and in production of seed and forage to the varieties of these crop plants ordinarily grown in the region. It is proposed to increase seed of these strains as rapidly as possible for distribution to farmers on the Bellefourche Reclamation Project and in the adjacent region. Tests of various grasses, both singly and in mixture, suitable for holding the surface of the large earth dam and of the canal banks on the Bellefourche Reclamation Project are being carried on in cooperation with the Office of Forage-Crop Investigations. A mixture of four species selected partly for rapid growth and partly for drought resistance has given very satisfactory results.

PHYSICAL INVESTIGATIONS.

The work of the Physical Laboratory during the past year, under the direction of Dr. L. J. Briggs, Physicist, has been devoted mainly to the extension of the lines of investigation described in the last report. This laboratory is charged with physical investigations pertaining to the different lines of work of the Bureau of Plant Industry and is working in close cooperative relations with a number of the other offices of the Bureau.

PHYSICAL INVESTIGATIONS IN DRY-LAND AGRICULTURE.—In cooperation with the Office of Dry-Land Agriculture, physical measurements are now being made systematically at eleven stations in the Great Plains region lying on the east side of the Rockies between the 5,000-foot contour and the ninety-eighth meridian. These measurements embrace a careful study of the environmental conditions under which each crop is produced, special attention being given to favorable and unfavorable factors which affect the development of the crop. A real knowledge of the environmental conditions under which dry-farming operations must be carried on in this region can only be obtained from observations of this kind carried on for a term of years sufficiently long to be truly representative of the area. Already marked differences in the environmental conditions have been found which have a great influence upon crop development. For example, the evaporation in the southern part of the Great Plains area during the summer season is almost twice that which occurs in the northern part, which illustrates the necessity of having a knowledge of other climatic factors than rainfall in determining the suitability of a region for dry-farming operations. The occurrence of hail and of precipitation in the form of torrential rains is another factor which has a profound influence upon the agricultural operations in some parts of the area.

The measurements have already been extended to dry-farming stations in the Great Basin region, and similar work will be undertaken during the coming season upon the experiment farms established under the direction of the Office of Western Agricultural Extension upon the United States reclamation projects.

ELECTRICAL RESISTANCE METHOD FOR DETERMINING THE MOISTURE CONTENT OF GRAIN.—During the past year a method has been developed, in cooperation with the Office of Grain Standardization, for the rapid determination of the moisture content of wheat samples. This method is based upon the resistance offered to the passage of an electric current through grain. The resistance decreases very rapidly as the moisture content of the grain increases. The work so far has been confined mainly to wheat. A great deal of interest has been shown in the method by persons engaged in the shipment and storage of grain, and many inquiries have been received regarding the applicability of the method to grains other than wheat and to grain products, such as starch and corn meal. The value of the method in connection with other grains and with grain products will be tested during the coming year.

FARM-MANAGEMENT INVESTIGATIONS.

The work of farm-management investigations has continued along essentially the same lines as heretofore, under the direction of Prof. W. J. Spillman, Agriculturist. The increase in the number of investigators in this office has required somewhat greater subdivision of the work than formerly. The farm-management districts have been grouped into three sections, each having a separate leader. One of these sections consists of the southern, another of the northern, and another of the western farm-management districts. The remaining work of the office is conducted under the general heads of farm-practice investigations, range management and cactus investigations, farm economics, and farm plans. A statement of the work of each of these subdivisions follows.

SOUTHERN FARM-MANAGEMENT DISTRICTS.

The southern subdivision of the farm-management work is conducted under the general direction of Mr. D. A. Brodie. It consists of seven districts, as follows:

DISTRICT No. 4.—This district embraces the States of Delaware, Maryland, and Virginia, and the work therein is in charge of Mr. H. A. Miller. During the past year special effort has been devoted to an attempt to induce farmers in the tobacco and peanut districts of Virginia and Maryland to grow their own hay and to adopt crop rotations that will include green-manuring crops. Several demonstrations have been started on selected farms with these ends in view, and general interest has been awakened among the farmers in these sections. Several farmers are following working plans formulated by Mr. Miller, with highly satisfactory results.

Another matter which has received attention in this district is that of depleted meadows in certain hay-producing districts in Virginia and Maryland. Many farmers are accustomed to leaving their meadows down for a long series of years, and the yields of hay of these meadows are not at all satisfactory. Special attention has been given to the practice of the best hay growers, with a view to ascertaining the conditions necessary for a production of maximum yields. In many parts of this district the land is in need of lime. A special study is being made of the effects of lime on the soils in those sections where its use seems to be advisable. In the more sandy regions, near the coast, special effort is being made to induce the farmers to make larger use of such crops as crimson clover, red clover, vetches, soy beans, and cowpeas, mainly for the effect that these crops have upon the fertility of the soil.

District No. 5.—This district consists of the States of North Carolina, South Carolina, Georgia, and Florida, and the work in these States is under the direction of Mr. C. L. Goodrich. The most notable development in the work of this district during the past year has been the extension of demonstration work, especially in the State of South Carolina. Mr. A. G. Smith has been employed for this work and is conducting extensive demonstrations in cooperation with the state experiment station of South Carolina, with the state department of agriculture, and with the farm-demonstration work conducted by Dr. S. A. Knapp, of this Bureau. The number who have volunteered to conduct this demonstration work has been very large, many more farmers, in fact, having volunteered than could be accommodated. Definite demonstrations have been started on about 30 farms. These demonstrations cover many phases of farming. Special attention is given to winter legumes as green-manure and winter-forage crops. During the past winter one cooperator grew 60 acres of winter vetch. Many of his neighbors will sow this crop this fall. As the result of one crop of crimson clover at Union, S. C., many hundred acres of this crop will be sown next season. On some of the farms the demonstration consists of the establishment of a definite rotation of crops on all or part of the farm. Others relate to depth of plowing, the use of fertilizers or lime, etc.

These demonstrations have shown that alfalfa is better adapted to the soils of the Piedmont Plateau than to the more sandy soils of the Coastal Plain. Bur clover has been found successful in all parts of South Carolina and is being largely sown as a winter cover crop and for green manure. It has been found best to plant it in the bur, as in this manner the plant carries its own inoculation. It has been found practicable to sow bur clover with cowpeas after corn or after a small-grain crop. The bur clover does not germinate until fall, and hence is not injured by the dry periods of summer. In these demonstrations hairy vetch has been found generally better than common vetch and has proved to be more resistant to frost. It does well all over the State of South Carolina. Interest in improved methods of farming is greater in South Carolina at the present time than at any previous time. As the result of the demonstration work, farmers generally are adopting better cropping systems and better methods of tillage and fertilization and are feeding more live stock.

During the year Mr. Goodrich has studied in detail the work of a very remarkable farm in South Carolina, and the results have been published as a Farmers' Bulletin. The owner of this farm has developed a worn-out, sandy farm that previously made only 8 bushels of corn and one-fifth of a bale of cotton per acre to a point where it now produces 2 bales of cotton, 85 bushels of corn, and 80 bushels of oats to the acre. The methods by which the land was brought to this high state of fertility are described in detail in the bulletin referred to.

District No. 7.—This district consists of the States of Alabama, Mississippi, and western Tennessee, the work being in charge of Mr. M. A. Crosby. The most notable result of the work in this district is the extension of alfalfa culture on the black prairie soils of Alabama and Mississippi. Five years ago a demonstration farm was established at Uniontown, Ala., on which 15 acres of alfalfa were sown. Since that time large acreages of alfalfa have been sown in that community. This season $3,000 worth of alfalfa seed was sown at Uniontown alone. The farmers of that section no longer fear the boll weevil. Alfalfa culture is extending rapidly over the prairie soils of the two States mentioned. More attention is being given to live-stock farming than formerly, especially to hog raising. The effect of alfalfa upon the fertility of the soil has been highly satisfactory. Land which yielded 18 bushels of corn before sowing to alfalfa has yielded 45 to 55 bushels of corn after being in alfalfa pasture for two years. Land which five years ago could have been bought for $20 an acre and which is now in alfalfa rents for $8 to $10 per acre. Attention has also been given in this district to winter legumes as green manure. It has been shown, as in South Carolina, that bur clover has the widest adaptability of any of the legumes for winter sowing in this district. Sowing in the bur has given better results than sowing the clean seed. Vetches and crimson clover have done well, but bur clover fits into the rotation with cotton better than these crops and it is out of the way in time for summer crops.

During the past year a careful agricultural reconnaissance has been made of the Fourth Congressional District of Tennessee. The special needs of his district are for better systems of cropping, especially those systems including leguminous crops. Soy beans are especially recommended. This reconnaissance strongly confirms the results obtained with soy beans by Director Morgan, of the Tennessee Agricultural Experiment Station. Many sections of the district are greatly in need of transportation facilities. Considerable areas of tobacco are grown in this section and the cultivation of this crop is extending. The section is adapted to all kinds of stock farming, and an effort will be made to encourage kinds of farming involving the feeding of live stock.

A great many farm plans have been formulated in this district, especially in those sections which are threatened by immediate invasion of the boll weevil. With the beginning of the new fiscal year an assistant will be placed in the State of Alabama to devote his whole time to demonstration work in connection with the agricultural experiment station of that State.

DISTRICT No. 15.—This district consists of the States of Arkansas and Louisiana, the work being in charge of Mr. A. D. McNair, with headquarters at Little Rock, Ark. The demands for lectures on farm management have been unusual in this district during the past year. Farmers are greatly interested in improved methods, and the demands made upon Mr. McNair are greater than he can meet. During the past year interest has centered in the extension of certain leguminous crops both for forage and for their effect upon the land. Special attention has been given to cowpeas. The cowpea crop is highly developed here and special study has been made of the farm methods in handling the crop. This study has extended into southeastern Missouri, western Kentucky, and western Tennessee. The cultivation of cowpeas is increasing in this section, due largely to the recent introduction of satisfactory thrashing machines. A large number of these machines were sold in the State of Arkansas during the past year. This district also includes the territory in which Japan clover, or Lespedeza, has its highest development as a farm crop. A careful study has been made of farm practice with this crop and a bulletin relating to it will be prepared at the close of the present season. As in the other southern farm-management districts, bur clover leads here as a winter cover crop. It is not of high value as a forage crop for the reason that stock do not greatly relish it, but it is very easy to get started, especially when sown in the bur, makes excellent green manure, and is not to be despised as a winter pasture. It has been determined that a bushel of seed in the bur weighs 14 pounds and is equivalent to 5 pounds of clean seed. From 2 to 3 bushels of seed in the bur should be sown per acre.

Extensive demonstration work has been conducted in the vicinity of Thornton, Ark., during the past year. As a result of this work 10 carloads of potatoes have been shipped out of that section this season. It is believed that the quantity of this crop produced next season will be much greater.

DISTRICT No. 16.—This district embraces the States of Texas and Oklahoma, Mr. B. Youngblood being in charge. The work in this district during the past has consisted mainly in making an agricultural reconnaissance in those sections of western and southern Texas into which there is at the present time a great influx of settlers. This work is timely and important, in view of the fact that a good deal of land is being sold in some sections where success is problematic. Study has been confined mainly to northwestern Texas, the so-called Panhandle country, west-central Texas, and extreme southern Texas. The Panhandle country consists of a high plateau and a lower plains area, the plains being divided into a northern and a southern section. In all this region settlers should be careful in selecting land and should use the utmost care in the management of the soil. Extended droughts are not uncommon. Crops that do best in the northern plains area are kafir, milo, sorghum, pumpkins, cushaws, and potatoes. Wheat and oats are rather uncertain. The most reliable crops in the southern plains area include those of the northern plains area and in addition cotton, cowpeas, peanuts, Bermuda grass, and bur clover. The uncertain crops are alfalfa, wheat, oats, emmer, and corn. Some of the small fruits and many vegetable crops are successful in ordinary seasons. In west-central Texas crop relations are about the same as in the southern plains area, becoming less certain in the drier parts to the westward. In all these sections the most successful men are stockmen who have control of considerable range and forage for winter feed.

In extreme southern Texas there are extensive areas having no water available for irrigation, being distant from rivers and having salt wells. The settler should carefully avoid such areas. Trucking has been the main type of farming attempted. In favored sections and certain seasons this has been very profitable. In some seasons, however, there is overproduction, with low prices. In other seasons crops fail quite generally for lack of rainfall, and the high prices which prevail are of benefit only to a few fortunate individuals who have good crops. In a few localities where good water is available for irrigation, trucking has been very successful. Settlers are cautioned to examine carefully into conditions with reference to the available water supply and the quality of the water before purchasing land.

District No. 8.—Work in this district, which embraces Kentucky, West Virginia, and eastern Tennessee, will be started August 1, 1909. Mr. J. H. Arnold, a graduate of one of our best agricultural colleges and an experienced farmer, has been employed to conduct the work in this district. During the ensuing year he will give special attention to the agricultural districts of these States and to the adaptability of the various crops and types of farming to this district.

District No. 24.—The work of this district, which includes the States of Oregon, Washington, and Idaho, with Mr. Byron Hunter in charge, is reported in connection with the southern farm-management districts because of the fact that Mr. Brodie, who has charge of the latter work, has a very intimate knowledge of the agriculture of the Pacific Northwest. District No. 24 is therefore included in his section of the work. Very gratifying results have followed the publication of certain bulletins relating to this district. Farmers' Bulletin 294, entitled "Farm Practice in the Columbia Basin Uplands," has had a marked effect in improving the tillage in the drier sections of these States. The result has been a marked increase in the yield of crops, especially wheat. Prior to the publication of Farmers' Bulletin 271, "Forage-Crop Practices in Western Oregon and Western Washington," thousand-headed kale was grown by only a few farmers in the Willamette Valley. Practically every dairyman in western Oregon now depends on this crop for succulent feed during the winter months, and it is rapidly becoming a popular crop in western Washington.

The study of weeds has been continued, and it has been learned that the small-leaved milkweed so troublesome in many of the grain fields of northern Idaho and eastern Washington can be completely eradicated by seeding the land to timothy or some other true grass and pasturing closely with sheep for two years. The grasses grow but little during the dry summer season, while the milkweed grows luxuriantly at that time. By pasturing closely each shoot is eaten off as soon as it appears above the surface of the ground, and in time the plant is exhausted. Two years are required to exterminate the pest. The grasses afford considerable pasture during seasons of the year when the milkweed makes little or no growth.

During the past year circulars have been issued entitled "Farm Methods of Applying Land Plaster in Western Oregon and Western Washington," "Clover-Seed Production in the Willamette Valley, Oregon," and "Hints to Settlers on the Umatilla Project, Oregon." The material for the last was obtained by making a careful study not only of the Umatilla project, but of other similar districts which have been longer settled. During the last two years considerable work has been done to determine the best crops for use as forage for hogs in this district. Material is now practically completed for a publication on forage crops for hogs in the Pacific Northwest. A number of diversified farms have been located in the wheat belt of eastern Oregon, eastern Washington, and northern Idaho. These farms are being studied and organized to furnish material for a bulletin on diversified farming in this district.

NORTHERN FARM-MANAGEMENT DISTRICTS.

The work in the northern farm-management districts is under the general direction of Mr. C. B. Smith. The work in some of the districts is not fully organized as yet, while in others it is well advanced. The districts and the leading features of the work in them are described in the following paragraphs.

District No. 1.—Investigations in this district, which includes New York and the New England States, are conducted by Mr. L. G. Dodge, assisted by Mr. M. C. Burritt. While the investigations in dairy farming, which have led to the publication of a Farmers' Bulletin entitled "Cropping Systems for New England Dairy Farms" and a bulletin of the Bureau of Plant Industry entitled "A Successful Dairy Farm," have been continued, increased attention is being given to a study of cropping systems for both sheep and hogs. Sheep farming is generally considered a decadent business in New England, but reports are coming in of farmers in these States who are making a success with sheep. Much of the rough pasture land of these States is well suited to sheep, and a study will be made of crops most profitably grown on these lands, special attention being paid to the use of rape, clover hay, pea and oat hay, and the like. Similar work in the growing of forage and pasture crops for swine will be undertaken, as there is a good demand in New England for light-weight, native pork. The usual method of heavy grain feeding in small pens is not profitable in New England. The study of systems of potato growing in New York and the New England States has been continued, and a Farmers' Bulletin dealing in detail with the methods which are being so successfully employed by farmers in certain sections of these States has been published.

Mr. Burritt, in New York, is making a study, in cooperation with Professor Warren, of the College of Agriculture of Cornell University, of the relation between different types of farming and their adaptation to different parts of the State. The farming over much of the State, especially in the hilly sections, seems to be carried on without much method, and on certain hill lands the failure of the clover crop appears to be the foundation of the difficulties that have resulted in the very poor condition of the soil there, where many farms are practically abandoned. Conspicuous exceptions are occasionally found even in the poorest sections, and the study of these exceptional farms will be carried on, as well as the study of the prevailing practices in good farming sections.

In both Maine and New Hampshire arrangements have been made to employ an assistant the coming year to study farm management in the two States in detail, in cooperation with the agricultural colleges. The work in Maine will be largely in the nature of demonstration work and will deal principally with cropping systems for dairy farms, the extension of the Aroostook system of potato farming to other parts of the State, the improvement of hay meadows, the production of seed corn, etc. In New Hampshire the cooperative work will relate mainly to the making of a detailed agricultural survey of typical areas selected in the various agricultural sections of the State.

District No. 3.—Farm-management investigations in this district, including the States of Pennsylvania and New Jersey, are in charge of Mr. G. A. Billings, who has given special attention to systems of management on the better class of dairy farms. Active district work in these States was only recently begun. A study is being made of the types of farming and farm methods that are most profitable on the various soils and in the different localities of the district. Thus far the work has been confined largely to central and southern New Jersey, but will be extended throughout the district as rapidly as possible.

District No. 9.—Investigations in this district, which embraces the States of Ohio, Indiana, and Illinois, were placed in charge of Mr. J. A. Drake at the beginning of the year. Clover, which is a fundamental crop in these States, is becoming increasingly difficult to grow on certain soils and as the result of certain systems of farm management. The location of these areas and the types of farm practices which will result in a normal growth of this crop are being determined. In Ohio cooperative work is being carried on with the state experiment station by which the office is furnished with a list of the most successful farmers of the State. These farms are being studied in detail. Wheat growing in some localities of the district is unprofitable, and a good many farmers substitute rye for this crop. The rye is lightly pastured in the spring by hogs. The hogs are then taken off until the crop is ripe, when they are again put on and permitted to gather the crop. Not only is this a profitable practice, but it saves labor and helps maintain the fertility of the land.

In certain sections of the district, as well as in other States adjacent, the soil is peculiarly adapted to corn, and exploitive systems of continuous corn cropping in occasional alternation with oats have been continued until the yields of both crops are so low as to make this type of farming entirely unprofitable. The necessity for changing this type of farming to some more profitable kind has forced itself on landowners, many of whom have applied to the Department for aid. To meet this demand, a Farmers' Bulletin on " Replanning the Farm for Profit " has been prepared and is now ready for publication. Considerable farmers' institute work was done last winter by Mr.

Drake, in cooperation with the Ohio State Board of Agriculture, and the board has requested that the work be continued the coming year. A certain amount of this work affords an opportunity for spreading a knowledge of the farm practices which have been found most successful in different sections of the district.

DISTRICT NO. 11.—Investigations of the farming problems of this district, which includes Michigan, Wisconsin, Minnesota, and the eastern half of North Dakota and South Dakota, are in charge of Prof. J. C. McDowell. In the northern portions of Michigan, Wisconsin, and Minnesota there are large areas of cut-over pine and hard-wood lands which can be bought for from $5 to $20 an acre and which can be made into productive, profitable farms if the right type of farming is practiced. These lands are being rapidly settled, usually by men of limited means and often by those unacquainted with the problems of farming in the North. Vital matters at the outset are a knowledge of economic methods of stumping and clearing the land and the adoption of a cropping system suited to the locality. Some of the most profitable crops are potatoes, clover, peas for seed and canning, and the small grains. For immediate returns potatoes are undoubtedly the most important crop for the new settler. In Otsego County, Mich., an attempt is being made through the organization of a county potato growers' association to introduce in a wholesale way, by means of lectures, literature, and personal advice, the practices of the best commercial potato growers in the United States. Mr. L. G. Dodge, of this office, in whose territory potato farming has reached a high state of efficiency, is aiding in this work. Matters that are being emphasized are a three-year rotation of potatoes, small grain, and clover, fall plowing, early planting, and the growing of but one or two of the best varieties. This work is meeting with much favor among the farmers. This type of work, using the county as a unit, will be used for emphasizing important lines of work in other sections of the district.

The jack-pine plains constitute another class of cheap lands in the North, rather low in quality, and attracting many settlers of limited means. Clover-seed farming on these lands from the outset is being strongly advocated as the surest type of farming to return a profit and build up the land. Many farm plans for these and the worn-out lands in the older sections of these States have been made during the past year. Early in the year considerable work was done in the dry regions of the Dakotas, and at the request of the Department of the Interior a circular, written by Professor McDowell and discussing the agricultural possibilities under the Williston Irrigation Project, was published.

DISTRICTS NOS. 13 AND 14.—These two districts, consisting, respectively, of Iowa and Missouri, have only recently been organized as separate districts, with Mr. M. E. McCulloch, formerly instructor in farm management at the Iowa Agricultural College, in charge of investigations in Iowa, and Mr. D. H. Doane, a graduate of the Missouri Agricultural College and for two years a special agent in this office, in charge of investigations in Missouri. In both districts arrangements have been made to carry on the work in close cooperation with the state agricultural college and experiment station.

WESTERN FARM-MANAGEMENT DISTRICTS.

Farm-management investigations in the West have only recently been organized as a separate section of the work of this office, under the direction of Mr. Levi Chubbuck, Expert. Mr. Chubbuck has for some years been connected with the industrial and agricultural work of the various Indian schools in the West, and has thus had an opportunity to become familiar with agricultural conditions generally in the territory in which his work lies. His headquarters will be at Denver, Colo. While the territory west of the one hundredth meridian includes practically half the area of the United States, only one-twelfth of our population lives in this region. Extending through 1,200 miles of latitude, varying in altitude from several hundred feet below to 14,000 feet above sea level, and having a rainfall which varies in different localities from less than 6 inches to more than 100 inches annually, agricultural conditions in this region are more varied than in any other region of this country. Wide variations of climate occur frequently in localities little distant from each other.

Except for the level, semiarid plains on the east and a few broad valleys near the Pacific coast, the agricultural lands of the region are found for the most part in narrow mountain valleys widely separated from each other. Manufacturing enterprises are few and relatively unimportant. Mining and lumbering are the chief industries which furnish a demand for farm products. Ranching is the chief type of agriculture. Farming under irrigation is extending, however, and some of the most intensive and most profitable farming of the whole country is found on these irrigated tracts. The region as a whole is newly settled, and the problems are often those of the pioneer who has not yet found what crops are best for his conditions and who has much to learn concerning the management of the soil, something that must always be learned by experience. The work to be done over much of this territory is to learn what crops do best in each locality, to learn what methods of tillage give best results, and to ascertain what types of farming fit best into local conditions of demand and of transportation.

Aside from the States of Oregon, Washington, and Idaho, the work in which, for reasons already explained, is included with the southern districts, farm-management investigations have been definitely organized in only one western district, though preliminary work has been done in two others, as noted below.

District No. 18.—This district consists of the States of Kansas, Nebraska, and eastern Colorado, the work being in charge of Mr. J. A. Warren, with headquarters at Lincoln, Nebr. A large part of the summer months was spent in studying the conditions prevailing, the farm practices obtaining, and the results secured in the semiarid portion of the district with a view to determining the possibilities of the region and the best methods of bringing about their fullest utilization. Many points in Colorado, Kansas, and Nebraska and a few in Wyoming were visited in this work, and a careful study of all available information made. Many farmers and ranchmen were interviewed and suggestions made for the management of their lands, and a number of public lectures were given. Considerable time was spent in continuing the study of farm management in eastern Nebraska and Kansas. Working plans were made for a number of farms in these regions. Suggestions for better management of farms were given to many farmers by private interviews and public lectures.

Incidentally a preliminary study of native legumes in their relation to crop production and rotation was made. During the year Mr. Warren prepared a paper entitled "Hints to Settlers on the North Platte Project, Nebraska," and has also published a circular entitled "Notes on the Number and Distribution of Native Legumes in Eastern Nebraska and Kansas." Mr. Warren has for several years been making a careful agricultural survey of the State of Nebraska, which is soon to be published by the Board of Agriculture of that State.

District No. 20.—This district includes Montana, Wyoming, and the Dakotas west of the one-hundredth meridian, the work being in charge of Mr. J. S. Cotton. With the increasing knowledge of proper methods of tillage in the conservation and crop utilization of soil moisture and because of recent favorable seasons of rainfall in the semiarid region, profitable farm crops have been secured and the interest of home seekers in these lands greatly stimulated. During the past season a study was made of farm-management problems over practically all of western North and South Dakota and in several counties in Montana, so that the office is in position to advise settlers as to the best methods of procedure. In Custer County, Mont., and Butte County, S. Dak., the greatest agricultural development will eventually come through the building of storage reservoirs at the mouth of small coulées in order to catch the surface water from sudden showers that occur more or less frequently through the summer season and store it for irrigation during periods of drought. As the rainfall is not always sufficient or is not favorably distributed for the successful growing of crops, small quantities of water judiciously used at the proper time will have much to do with the farmers' welfare. In these counties more than 50 per cent of the land is too broken for economical agricultural purposes. In order to get the most out of the range land and also out of these farms, the greater part of the produce grown on them should be fed to live stock ranging over the areas too rough for successful cultivation. An article entitled "Hints to Settlers on the Sun River Project, Montana," by Mr. Cotton and Mr. W. A. Remington, has been issued.

District No. 22.—This district consists of Arizona and New Mexico. In connection with his investigations relating to range management and cactus culture, Dr. David Griffiths, of this office, has given some attention to farm-management problems in these two Territories. A fairly complete agricultural reconnaissance of New Mexico has been made, so that the office now has a fair knowledge of the agricultural sections of that Territory.

FARM-PRACTICE INVESTIGATIONS.

In this section of farm-management investigations certain phases of farming are studied in all parts of the country. The principal problems under investigation are as follows:

Hay and haymaking.—Studies of the curing and marketing of hay in the United States have been continued throughout the year by Mr. H. B. McClure. Farmers lose an enormous amount of money each year on their hay crop because of a lack of knowledge of the kind of hay and character of bale that the various city hay markets demand. Much of the hay intended for city markets is cut when too ripe. A very large proportion is weedy or badly mixed with various grasses, giving it a low grade on the market. Growing hay for home use and growing it for the market are two very distinct things. The legumes which when mixed with timothy give the hay a low grade on the market may well constitute the bulk of the crop when fed out on the farm. These and many other matters have been published in a Farmers' Bulletin entitled "Conditions Affecting the Value of Market Hay." Investigations of the artificial curing of hay, particularly alfalfa, are under way. Cooperative plans have been made whereby the use of a steam engine and boiler and the inside machinery for a drying kiln have been secured.

WEEDS AND TILLAGE.—Investigations on the control of our most serious weed pests have been continued by Mr. J. S. Cates, assisted by Mr. H. R. Cox. A circular describing in detail the agronomic habits of the wild onion and suggesting means of control and a Farmers' Bulletin giving results of investigations on bindweed or wild morning-glory have been issued. The experiences of many farmers have confirmed the methods advocated for the control of Johnson grass in Farmers' Bulletin No. 279, and preparation is being made for a second bulletin on this subject. The office is now cooperating with about 150 farmers in studying the relation of weeds to the tillage needs of corn and cotton. Investigations under way have been extended to include rice weed pests, Canada thistle, sheep sorrel, orange hawkweed, quack-grass, and several other important weeds.

FARM PRACTICE ON MUCK LANDS.—In the central Northern States are large areas of swamp and muck lands that with proper handling make profitable farms. Much land of this character is already under cultivation, and there are still very extensive areas of cheap swamp lands, particularly in Wisconsin, Minnesota, and Michigan, yet to be brought under cultivation. The work of investigating systems of management on these lands has been in charge of Mr. J. A. Drake. After clearing and draining, these lands are especially well adapted for hay and pasture. Grass grows readily, especially after the land has been burned over. Large areas are being sown by simply disking and harrowing after the fires have passed over. Farther south excellent corn can be grown, and in many instances potatoes of good quality. It is a popular belief that all swamp lands of a peaty nature are deficient in potash. While this is true of most of the swamp lands in the North, many areas were found, particularly in Iowa and Ohio but also in Wisconsin and Minnesota, where phosphoric acid is of first importance. A paper on the general management of these lands is in preparation.

FARM PRACTICE IN POTATO-GROWING SECTIONS.—Potato growing is an important phase of farming in district No. 1 and has led Mr. L. G. Dodge, who has charge of that district, to a more extended investigation of systems of farming involving this crop in other sections. A Farmers' Bulletin has been issued dealing with potatoes as a farm crop in the Northern States. The office is cooperating with the

Office of the Horticulturist and the Office of Cotton and Truck-Crop Diseases in an attempt to solve a difficulty found this year in the germination of seed potatoes along the Atlantic coast. It is extremely difficult to determine whether this trouble is due to conditions where the seed was grown in the North or where it is planted along the coast. Mr. Dodge's work with systems of farming involving potato culture has now reached such a stage that he is in considerable demand by other district men in helping to introduce such systems in their respective sections.

Manures and fertilizers.—Investigations of the farm use of manures and fertilizers have been continued during the year by Mr. J. C. Beavers, working chiefly in the South Atlantic Coast States. In practically all of this region matters of first importance in increasing crop yields and profits and for securing the maximum benefits from the use of commercial fertilizers applied are a systematic rotation of crops in which legumes form a prominent part, deep plowing, and an increase of the humus content of the soil. During the last two years sufficient data have been collected concerning the practice of the most successful farmers in the region mentioned to show a very important relation between the general character of the soil and the amount, both actual and relative, of the various fertilizing ingredients required for best results, especially with cotton. It would also appear that fertilizers applied to corn after the crop has made considerable growth may be highly beneficial.

Systems of management on dairy farms.—Mr. George A. Billings, who has charge of this project, has continued his investigations through the year, studying individual dairy farms in the milk-shipping districts of New York, New Jersey, and Pennsylvania, as well as dairy-farm conditions and practices in several other Northern States. The feeding of soiling crops in the summer or of silage the year around is proving to be an important factor in the commercial production of sanitary milk. Much information has been secured on the cost of producing sanitary market milk under different systems of farming and dairy management. This work will be continued. During the year a large number of detailed working plans have been made by Mr. Billings at the request of dairy farmers in different sections of the country. The farms on which these plans are put in operation will serve as models for the community in which they are located.

Forage for stock.—Investigations of the cropping systems on farms producing live stock are being studied by Mr. J. S. Cotton. Data are now at hand for formulating cropping systems for those farmers in the corn-belt States, southern Michigan, and Kentucky who desire to follow stock farming to build up or maintain their farms at a high state of productiveness. In many parts of Kentucky some form of live-stock farming is essential to the economic handling of the land. In the investigations relating to forage for sheep, Mr. Cotton has been assisted by Mr. D. H. Doane, who has made a special study of the use of catch crops sown in standing corn at the last cultivation of the corn, to be pastured off with the corn crop. Under favorable conditions this practice is very satisfactory. During the coming season special attention will be given to the study of forage for sheep in the Eastern States. This will comprise the study of the crops used or needed and of the best rotation for securing a sufficient amount of forage on sheep farms. It is believed that sufficient data will soon be on hand to enable us to make complete cropping systems for stock farms in all of the Eastern and Central States.

Clearing logged-off land.—While millions of acres of land have been cleared in this country, the available data concerning the best methods of clearing and the cost of the operation are extremely meager. During the past year definite investigation of this subject has been undertaken, Mr. Harry Thompson having general charge of this work. A great deal of land has been cleared in recent years in western Washington, western Oregon, and northwestern California. The work during the past year has consisted of gathering all available information from those who have done work of this character. The data secured was so important that it has been published as Bureau of Plant Industry Circular No. 25. During the current year these investigations will be continued and definite data secured from a large number of crews engaged in clearing land. The legislature of the State of Washington at its last session appropriated $5,000 to be used in these investigations in that State in cooperation with this Bureau. Cooperative arrangements have been made with the experiment stations of Wisconsin and Minnesota to extend these investigations to those States, each of which will bear a part of the expense of the investigations.

Cassava investigations.—Prof. S. M. Tracy, of this office, has continued his investigations relating to cassava as a farm crop. These investigations relate mainly to securing strains of cassava that will reproduce true to seed. Three such strains have been produced and are now being propagated on a considerable scale. By propagating this crop from seed instead of cuttings the region to which the crop is adapted may be greatly extended, especially in those sections of the Gulf coast where corn does poorly. The cassava crop to a certain extent replaces corn on stock farms.

Phenological investigations.—Mr. H. A. Miller has continued the work of collecting data concerning the dates of planting and harvesting crops and the dates at which a crop planted at a given time reaches the stages at which it can be utilized for various purposes. We have now sufficient data of this character for most sections of the country to be of great value in planning intensive cropping systems involving the ordinary farm crops.

FARM ECONOMICS.

The work in farm economics is directed by Mr. W. A. Peck, assisted by Mr. L. W. Ellis. The principal lines of investigation follow.

Farm organization.—This project is a detailed study of individual farms to provide data for effecting an economic farm organization. Studies this past year have been carried on with only a few farmers, mainly with the idea of working out and perfecting a system for collecting reliable data. Cooperation has been established directly with some 20 farmers in Wisconsin, Indiana, Iowa, and Maine, and indirectly through cooperation with the Ohio experiment station with some 35 farmers in Ohio. A study has been made on each farm of the business system as seen in the capital investments, daily distribution of labor, arrangement and size of fields, sales and expenditures, and the relative profitableness of field-crops and live-stock products.

A system for collecting data has been worked out to a satisfactory conclusion, so that cooperation with farmers may be extended as rapidly as circumstances will permit. Complete labor reports, showing hours of labor devoted to the various farm operations as well as showing the daily distribution of the same, have been received from these farmers, so that we have been able to determine the labor cost of producing field crops and live-stock products. Financial accounts, showing farm receipts and expenditures, have also been received from a number of these farmers. Complete farm inventories have been made and farms surveyed to determine crop acreages and field arrangement. Beginning with January, 1909, we have been furnishing the farmers with monthly statements of their reports. The reports from the Ohio farmers are sent directly to the Ohio experiment station, where the tabulations are effected. Summaries of statistical data collected are now being made, and these will be prepared for publication in bulletin form in the near future.

Plans for next year contemplate cooperation with the Wisconsin University, which will take the tabulation of the records from the Wisconsin farmers from this office to the office in Wisconsin. Plans are also projected for establishing cooperation with farmers in the irrigated section of the West and in Iowa and Missouri, in addition to increasing the number of cooperators in the States from which reports are now being received.

FARM BOOKKEEPING.—This project has three objects, viz: (1) To work out methods of collecting reliable data in the study of farm organization; (2) to work out a system for keeping farm financial accounts for farm use; and (3) to work out for farm use a system of cost accounting dealing with labor, equipment, and performance records, together with supplemental records for field crops, etc. The methods of collecting farm data have been satisfactorily worked out as regards labor records and financial accounts. The system of financial accounts for farmers' use, originated in 1907, has been used on a number of farms to test its practicability. Several changes in the original form were necessary. A bulletin on this subject is now in preparation.

EQUIPMENT.—Mr. L. W. Ellis is devoting his entire time to the study of farm buildings, machinery, tools, fences, etc., for farms of different types and sizes. The study of farm buildings has reference to arrangement, annual investment, depreciation, interest, repairs, and total cost annually per head of live stock, bushel of grain, ton of hay, etc. Equipment studies have been made through farm inventories, available literature, and equipment catalogues. Complete inventories, collected by Mr. Ellis and Mr. H. C. Thompson, have been made on representative farms in nine of the Central States, the number ranging from ten to thirty in each State. Catalogues from over 1,000 manufacturers of machinery and implements have been assembled, filed in alphabetical order, and indexed. A general survey has been made of conditions throughout the Dakotas, Kansas, Colorado, Texas, and California. Throughout these States special investigations were made as to plowing by the use of mechanical power. During the spring of 1908 studies of equipment were made on twenty-three Ohio farms in connection with the cooperative record work. The compilation of the material collected has progressed to such a state that a report or bulletin will be submitted during the coming year.

Farm plans.—The work of formulating working plans for farms has increased very materially during the past year. This work is of great value in studying the underlying principles of farm plans. Work of this character is almost entirely new, and many hundreds of plans must be drawn, including plans for all types of farms in all sections of the country, before general rules for such work can be deduced. Planning a farm requires no small amount of mathematical calculation and usually includes the drawing of a map of the farm, with the fields properly arranged for a suitable cropping system. In order to facilitate this work and to relieve the district men from the burden of the necessary drawing and calculations, a section of farm plans has been organized, the work being in charge of Mr. J. W. Froley. Mr. Froley has already collected a large amount of data required in this work, such as the amount of feed required by different kinds of stock, yields of crops, practicable rotations, etc., and has constructed a number of tables that are highly useful in making the necessary calculations.

RANGE-MANAGEMENT AND CACTUS INVESTIGATIONS.

Investigations in range-management problems and the culture, development, and use of economic forms of cactus were continued during the year as heretofore, in charge of Dr. David Griffiths.

Prickly-pear investigations.—The very destructive drought which has obtained in southern Texas during the first half of the calendar year has demonstrated beyond any doubt that no man raising cattle in that section can afford to be without a good supply of prickly pear for forage at all times. It is the best insurance against famine that a farmer can have in that region. At the same time it makes good roughage for cattle, sheep, and swine, as well as excellent succulent feed for the dairy at all seasons. Evidence secured during the past year by Doctor Griffiths demonstrates that prickly pear well cultivated will seldom, if ever, suffer from drought in southern Texas. Uncultivated pear, on the contrary, often does.

During the past year two "spineless" species have been secured which have withstood the temperatures of San Antonio during the past winter. One of these is a cultivated species and the other a selected native. Both of these have withstood the low temperature of the past winter out of doors without injury. They are not as rapid in growth as the *Opuntia ficus indica* group, but are still rapid enough to be promising as stock for breeding with the less hardy "spineless" varieties of more rapid development. It is by the use of the least spiny, most prolific hardy natives crossed with the "spineless" cultivated forms that it is expected to get finally a rapid-growing "spineless" pear which will be hardy in this region. This seems probable of accomplishment at the present time. Until this result has been attained the spiny natives should be cultivated, unless the rancher or stockman has enough available in the natural state. Even then a small area well cultivated would often be advisable as an insurance against shortage of feed in the last stages of an excessive drought and could, of course, be utilized at any season.

During the year the Department has been instrumental in distributing nearly 10 tons of cuttings of "spineless" varieties to the less frosty sections of the country where there is a probability of their succeeding. In spite of this there have been about 200 applications deferred until next spring's distribution, owing to lack of stock. We have now about an acre of ground devoted to the propagation of "spineless" forms. The increase of this will be distributed each year until the public demand is filled. It is quite likely that more ground will have to be devoted to propagation next spring. A bulletin on "The 'Spineless' Prickly Pears" has been issued since the last report.

Range investigations.—In the northwestern region Mr. J. S. Cotton has, during the past year, secured further data confirming previous reports, proving, first, that there is little chance for improvement of the dry ridges and hillsides in the California mountains except by the slow process of natural restoration through protection from overgrazing; second, that seeding is practicable only upon moist mountain meadows; third, that the grasses most promising for the improvement of the mountain meadows are timothy, redtop, and orchard grass, although alsike clover has been found valuable locally; and, fourth, that the reclaiming of mountain meadows which have been destroyed by the erosion of a deep gully, through the aid of small dams of brush, rock, and earth, thus filling up the gorge by sedimentation, is practicable in the Sierra Nevada Mountains. A publication is being prepared at the present time upon these investigations.

The work upon the Santa Rita National Forest in Arizona has been continued by Doctor Griffiths, in cooperation with Director Forbes, of the Arizona experiment station, and has demonstrated the following facts: First, that the perennial grasses in that region which, on account of their greater palatability to stock, have been crowded out by the weedy annuals will regain ascendency when the lands are properly handled; second, that this will take place without stock being removed entirely; third, that the best grazing lands, at an altitude of 4,000 feet and upward, will rapidly recover under moderate grazing to a carrying capacity of at least one mature bovine animal to 30 acres—the indications are now that they will really do better than this; fourth, that the open grassy foothills of this entire region are gradually being covered with brush and will probably become in time as brushy as the drier desert mesas below; fifth, that the encroachment of brush upon the once grassy areas is due to the prevention of fire, for which the stockman's operations are directly responsible; sixth, that a ground cover at an altitude of 3,000 to 3,500 feet accumulates very slowly and will be almost entirely dissipated by a single dry year, even in the areas protected from grazing—below this altitude a ground cover is not at all a factor in production, but a ground cover of débris increases gradually upon the gentle slopes above 3,500 feet when lands are protected from excessive grazing; seventh, that out of 200 or more varieties of plants whose seeds have been sown, alfilaria is the only one that has produced any economic results, and this plant apparently does not thrive in this situation except in most favored localities; and, eighth, that the indications now are that in this situation alfilaria thrives better where the perennial grasses are held in check somewhat by native annuals when the latter are not fed off too closely.

Progress has been made during the past year upon the study of the composition of native forage plants, in cooperation with the Bureau of Chemistry. A bulletin is now being prepared including the first installment of the results of these investigations.

FARMERS' COOPERATIVE DEMONSTRATION WORK.

The farmers' cooperative demonstration work, under the direction of Dr. S. A. Knapp, Special Agent, has been considerably extended during the past fiscal year.

EFFECT OF THE WORK IN TEXAS.—It has always been realized that one of the difficult problems in the production of greater crops is to induce farmers to accept the better methods and put them into practice. To solve this problem the demonstration work was organized in Texas, under Doctor Knapp, in 1904. The proper cultural methods of growing cotton under boll-weevil conditions had been demonstrated in isolated cases, but the masses had to be shown by object lessons or demonstrations how to avert a panic in this great industry from lack of confidence that a crop could be made. The magnitude of this task may be estimated when it is noted that according to the last census (1900) Texas alone contained 352,190 farms, and this number has been increased with great rapidity since that date.

DEVELOPMENT OF THE WORK.—From its commencement the demonstration work has been extended beyond the newly infested territory with the intention of preparing the farmers and averting a panic. Excellent crops have generally been produced where demonstration methods have been followed, even in territories having the worst infestation.

The effective character of the demonstration work has been so fully proved that public opinion is largely crystallizing around it as a method of mass teaching and reform that is certain, if continued, to revolutionize agricultural conditions in the United States.

PRODUCTION OF HOME SUPPLIES ON THE FARM.—The systematic campaign for each farmer to produce the food for his family and stock, so as to make a greater net profit and add an element of safety, has been advocated during the past year with more than usual energy, and the effort is fast bringing results in reduced loans and a greater independence of the farmer. The consensus of opinion throughout the Southern States is that the crops of the present year have been made more economically than usual and that the net return will show a most satisfactory profit.

A large number of demonstrations have been made on corn which have resulted in the general adoption of improved methods by the people of the different States, as shown by the greater acreage and increased yields per acre in every Southern State. In ten Southern States the statistics show that the corn crop of 1908 was $162,000,000 greater in value than that of 1903, and the hay crop of 1908 was $100,000,000 greater in value than the hay crop of 1903.

Reducing the fertilizer bill.—Reports from the Bureau of Statistics of this Department show that the commercial fertilizer consumed in 1908 in Virginia, North Carolina, South Carolina, Georgia, Florida, and Alabama amounted to 2,490,709 tons. This can largely be reduced by the saving of home fertilizers and especially by the growth of more legumes. A very large number of demonstrations with cowpeas, vetch, crimson clover, etc., have been made, showing their value not only as a soil builder but as a special protection to the soil against leaching and washing. This is particularly true where crimson clover is used.

Rice demonstrations.—In the Yazoo Mississippi Delta a small demonstration has been made this year (1909) in the production of rice, with splendid success. Many of the leading planters in that section have visited this demonstration, and there will probably be 5,000 acres of rice grown in this territory next season, thus utilizing lands which have always been likely to fail in other crops on account of poor drainage or levee seepage and which are especially unfitted for cotton under boll-weevil conditions.

Extension of the work.—Through constant appeals from farmers a portion of the appropriation for the fiscal year 1909–10 was made immediately available by Congress in March, 1909. With these funds the demonstrations were largely increased in the States of Louisiana and Mississippi during this spring, thus reaching by aid of Congressional appropriation the principal portions of Texas, Oklahoma, Louisiana, Arkansas, and Mississippi. The General Education Board of New York, realizing the excellent results which are being obtained through their cooperation with this Bureau, have not only continued but have increased their appropriation for our work in the States of Alabama, Georgia, South Carolina, North Carolina, and Virginia, with extension into Florida for the first time this year.

The men employed in this work in the above States are under the direct supervision of Doctor Knapp, representing the Bureau of Plant Industry, but the entire expenses of the work are defrayed by the General Education Board.

Demonstrations among negroes.—While all classes of farmers are aided in each locality, special work is being done among the independent negro farmers at one point in Mississippi, two in Alabama, one in Georgia, two in South Carolina, and four in Virginia. At these points negro agents are employed, mainly cooperating with the principal negro schools in their vicinity, and especially with Hampton Institute, in Virginia, and Tuskegee Institute, in Alabama. A part of the expense of this work is defrayed from the John F. Slater Fund.

Organization.—To prosecute this work successfully a thorough systematic business organization is required, and the present division of the force employed into state, district, and local agents has proved very satisfactory.

A system of keeping in touch with these field men similar to those used in commercial lines has been adopted. Aside from the usual instructions, weekly itinerary reports are required showing the travel performed during the week, together with a proposed itinerary for the next week. Added to this is a weekly field report showing exactly what has been accomplished, which is sent in through the district and state agents so that everyone may be kept constantly advised. The organization for the present season consists of 12 state agents, each of whom has direct charge of a force of district and local agents varying from 15 in Oklahoma to 43 in Louisiana. In Florida, where the work has just been begun, the force of agents is now being organized. All of the state agents and their district and local agents work under the direction of the Washington office, which now consists of Doctor Knapp and 5 assistants, with a clerical force of 19.

Cooperation with local organizations.—At many points in the different States, and especially in the State of Mississippi, the work has been greatly increased through the cooperation of counties and business organizations. In many cases they pay for the seeds used upon demonstration farms and pay a portion of the salary of our agents in charge. This does more than to give financial aid—it greatly strengthens the moral force, increases the educational effect, and tends to show the tremendous interest which the different localities are taking in the work.

Cooperation with schools.—Special attention has always been paid to cooperating with state authorities, experiment stations, agricultural colleges, and all other agricultural agencies. During the past year this line of work has been greatly extended. In a number of States a closer cooperation with the agricultural and mechanical colleges has been effected by mutual agreement, to the great advantage of all. Through this arrangement the increasing demand for demonstration work in connection with schools and colleges has been successfully met. This college cooperative plan also provides for managing the demonstration work among school boys. This work among the school boys was started in a small way in previous years, and during the past season there have been 12,500 boys enrolled who have conducted demonstrations in corn and cotton on their fathers' farms. The prizes for this work have been donated by the local people. This boys' demonstration work has proved of great value.

Seed-selection meetings.—Besides the general agricultural meetings held by our agents throughout the year, special attention is being given to meetings for the sole purpose of seed selection. These meetings, which are held in every community in which demonstration work is being conducted, are held in the fields at the time the seed should be selected, and practical instructions are given. Such meetings are also held in the spring just before planting.

Publications.—Aside from the large number of applications for Farmers' Bulletins of the Department, this office has issued and distributed during the last fiscal year seven circulars on various subjects connected with the work, in editions ranging from 40,000 to 115,000 copies. In all, more than a half million of these publications have been distributed.

Plans for future work.—In accordance with a general understanding, no increase in appropriation has been asked for the next fiscal year, but through economical business methods, and especially through cooperation from outside sources, the additional demands for the work will be supplied as rapidly as possible, although from the very large number of applications on file, it is realized that it will be impossible to cover intensively more than a part of the territory, unless communities will share a portion of the expense.

ARLINGTON EXPERIMENTAL FARM AND HORTICULTURAL INVESTIGATIONS.

The maintenance and operation of the Arlington Experimental Farm, as well as the related investigations in horticulture, have continued under the immediate charge of Prof. L. C. Corbett, Horticulturist, and good progress has been made.

ARLINGTON EXPERIMENTAL FARM.

The same general policy which has been heretofore followed in connection with the development of the Arlington Experimental Farm has been continued during the past year. Many problems of a general nature in connection with crop growth, crop conditions, and crop nutrition are being studied by the various offices conducting work at the farm.

INVESTIGATIONS CONDUCTED BY VARIOUS BUREAUS.—The Forest Service maintains an osier-willow plantation at the farm for the purpose of studying cultural problems, as well as testing varieties. During the year this plantation has been considerably extended. The Bureau of Entomology maintains an orchard and nursery for the study of orchard pests, and a mulberry plantation for supplying food for silkworms. The growing of seedling mulberries for distribution has been discontinued. The Bureau of Soils has an area devoted to crop rotation for the study of the normal effects of rotation upon soil conditions, as well as an area upon which the effects of pure chemicals of various kinds not generally considered as fertilizers are being tested to determine their value as plant foods and to study their effect upon the plants themselves. More than 80 distinct experimental plats are involved in this study. The Bureau of Chemistry is cooperating with the Bureau of Entomology in its study of insecticides at the farm.

The Bureau of Plant Industry is represented by twelve distinct offices conducting field investigations at the farm. About 85 acres are devoted to this work, for which the farm provides general facilities, such as tools, implements, and necessary assistants. The work of this Bureau covers forage crops, grains, drug plants, fruits, and many other crops and crop problems.

SOIL IMPROVEMENT.—The same plan which has been in practice from the beginning of the soil-improvement work has been followed with gratifying results. While arrangements have been perfected by which a very large quantity of manure from the military post at Fort Myer, Va., will from this time on be available, the original plan of demonstrating the feasibility of improving the land by the use of leguminous crops combined with lime and the use of mineral fertilizers, principally phosphoric acid, will not be discontinued. The results already obtained and briefly mentioned in last year's report are sufficient evidence to warrant farmers in the coastal plain region of the South Atlantic States to undertake the rehabilitation of their soils in this way.

Nursery work.—The farm nursery work has been conducted along the same lines as heretofore. About 4,225 apples in 80 varieties were grafted, and 1,162 plants of various ornamental shrubs and 10,000 privet plants were rooted from cuttings during the winter and spring months. There are now growing in the nursery 5,402 fruit trees, 1,824 fruit-tree seedlings from stocks, 4,225 apple grafts, 273 bush fruits, 9,292 ornamental trees, 3,066 ornamental shrubs, 16,800 privet plants, 3,700 mulberry seedlings, and 1,941 hardy herbaceous perennials.

Landscape work.—The lawn areas on the farm have been slightly increased and the planting of shade trees and ornamental shrubbery has been continued as heretofore. In connection with the landscape work, the Office of the Horticulturist has been called upon to prepare planting plans for the Morgan Horse Farm by the Bureau of Animal Industry, for the Naval Proving Ground at Indian Head, Md., by the Navy Department, and for a number of colleges and schools directly interested in agricultural education. While the time and equipment of the office will permit of but a small amount of this work, it is believed that as a result of the object lessons which will be afforded by well-planned plantings about educational institutions a desire for similar improvement may be created on the part of the rural population in the surrounding country.

Greenhouse work.—The last two of the ten greenhouses necessary to complete the range as originally planned are now being erected. The heating plant has been completed by the installation of a third boiler and a change in the location of the heating main leading from the boilers. During the year 1,704 rose plants, 5,667 carnations, and 8,062 bedding plants were propagated from cuttings. A large number of annual flowering and vegetable plants were grown from seeds for use in the vegetable testing gardens. The study of blind versus flowering wood cuttings has been continued as mentioned in the previous report. The area devoted to nutrition investigations of greenhouse crops has been considerably increased. Four units of the experimental range of greenhouses have been devoted to lettuce, two to cauliflower, and three to carnations. One unit has been devoted to a variety test of forcing tomatoes, another to a similar test of forcing melons, and two to the propagation of plants.

General farm improvements.—The electric power which had just been installed at the time of the last report has proved a very useful and economical improvement, practically all of the tools in the blacksmith and pipe-fitting shop, several of which have been obtained during the year, being propelled by this power. A local telephone system, consisting of seven stations connecting all the farm buildings, has been installed. A new one-story building, 34 by 130 feet, to be used as an implement shed and fertilizer house, is now being erected. A steam roller recently transferred from the Office of Public Roads proves a very useful addition to the farm's equipment, not only for rolling the farm roads, but to furnish power for thrashing, stone crushing, etc. The farm equipment has been increased during the year by the purchase of two horses, a grain drill, a fertilizer distributer, a manure spreader, a horse lawn mower, a wagon, and several small tools. Sufficient 4-inch pipe has been secured to continue the water main to the barns. Several of the wooden farm bridges have been replaced by large terra-cotta sewer pipes, and the work of replacing others is being continued. Very little tile draining has been done during the year, but considerable attention has been given to surface drainage, catch-basins having been constructed at the more important drainage basins along the farm roads to prevent the accumulation of water. These have been of much benefit in keeping the land in good condition.

HORTICULTURAL INVESTIGATIONS.

As pointed out in the last report, various special problems of a horticultural nature are being worked out in connection with the Arlington Experimental Farm. These problems have reference to the handling of those garden crops which are extensively cultivated through the South as truck crops and at the North as market-garden crops. Field work is being conducted at a number of localities.

Truck-crop survey.—The work of gathering information concerning the areas devoted to the several important truck and market-garden crops has been continued by studying each of the several crops in the different localities where they are grown on an extensive scale. Special studies of the onion, potato, sweet potato, and celery industries are under way and will be described later. In addition to these, the cabbage industry has been taken up from the standpoint of the southern truck grower, who grows cabbage as an early crop for northern consumers, as well as from the standpoint of the market gardener and farmer at the North, where it is grown for winter consumption, for storage, and for the manufacture of sauerkraut. The field-bean and snap-bean industries of the eastern half of the United States, as well as the Lima-bean industry of the Pacific coast, have been investigated and the results published in Farmers' Bulletin 289.

It will thus be seen that investigations covering the major crops of the list of truck and market-garden vegetables are under way or have been reported upon. The survey work naturally brings to light the important problems connected with the industry in each of the several regions, and as rapidly as the facilities of the office will permit the most important of these great economic problems are being taken up.

Plant nutrition.—The problems of plant nutrition are among those of most vital importance to the truck farmers and intensive gardeners. Two of the areas in which these problems are most acute at the present time are the country around Norfolk, Va., and the eastern portion of Long Island. In both of these districts extensive nutrition tests are under way to determine the requirements of the several crops commercially grown. Naturally potatoes play an important rôle in both localities. The question of the kind and quantity of plant food that can be economically used is very important, as is also the problem of maintaining the physical properties of the soil. To determine these points not only involves an investigation of the kind and amount of fertilizer to use, but its place in a rotation which shall preserve the humus content of the soil and add to its fertility. As a result of the investigations already made in the Norfolk area a number of the most progressive growers are using cowpeas extensively following early truck crops, to be turned under as a means of increasing the humus content of the soil. This practice is rapidly correcting many of the evils of a system of farming long conducted on the basis of commercial fertilizers *minus* humus—a ruinous system. A rotation which combines commercial fertilizers with humus either in the form of manure or a green crop turned under is bound to improve crop yields and lessen nutrition troubles. The work has progressed far enough to warrant the foregoing statement, but the best rotation and the most economical combination of nutrition for each particular crop and locality is yet to be determined.

POTATO TESTS.—The variety test of Irish potatoes has been continued. The collection this year contains 162 varieties of the original collection of American and European potatoes. To this have been added 62 two-year-old seedling varieties grown at the Arlington Experimental Farm last year, 74 varieties from the Vermont Agricultural Experiment Station and other American localities, and 115 varieties of both wild and cultivated potatoes from the mainland and archipelago of Chile, making a total of 413 different sorts. In addition to this, about 2,500 seedlings have been grown from seed of wild and cultivated varieties of native Chilean potatoes. Variety tests are also being made at Burlington, Vt., and on Long Island. Another line of work is the growing of seed stock of several varieties of potatoes in Vermont, New York, and West Virginia in connection with the problem of determining the best source of seed for the early southern potato crop. The fertilizer experiments with potatoes and other truck crops have been continued, with excellent results.

SWEET POTATOES.—During the past year very material progress has been made in the work with the varieties of sweet potatoes, especially in the matter of introducing standard sorts in localities where they have not been previously grown. Observations as to comparative yield of varieties and the various problems connected with the storage of sweet potatoes for winter marketing were continued. An investigation of the commercial production of sweet potatoes has been made, and the results have been published in Farmers' Bulletin 318.

ONIONS.—During the past year the Office of the Horticulturist has procured through the State Department a quantity of seed of the genuine Denia or Spanish onion. This seed was distributed to reliable experimenters, several of whom have produced onions that are equal or superior to those that are imported in such large quantities. Special attention has been given to the production of onion seed and sets from a farm standpoint, and the manuscript for a bulletin along this line has been submitted for publication. A study has also been made of the Texas Bermuda-onion industry.

CELERY.—The work with celery has been continued with special reference to the securing of disease-resistant varieties that will be adapted to the requirements of both the grower and the consumer, and also to the problems connected with the storage of northern-grown celery for winter marketing. These investigations have included a study of the production of celery as a late crop at the North, involving its harvesting and storage, and as a winter crop at the South, where it is extensively grown for shipment to the North for immediate consumption. The area yet uninvaded by this work, which it is hoped will soon be embraced, is that of the southern Pacific region, where celery is extensively grown for winter consumption.

Peanuts.—The peanut has received attention especially from a forage and oil-producing standpoint. Imported varieties from various parts of the world, including the famous peanut regions of the Gold Coast of Africa, have been grown and compared with varieties now being grown in this country. An experiment has been inaugurated to determine the possibilities of producing peanut oil commercially in this country. The crop grown the second year from one variety of imported seed showed an oil content of nearly 54 per cent, which is considerably above the general average found in American nuts. Investigations and tests of the machinery required in the manufacture of oil from peanuts have been undertaken, and both oil-mill owners and farmers in the boll-weevil districts of Louisiana and Texas, where soil conditions are favorable to the peanut, have been encouraged to undertake extensive experiments in peanut-oil production.

Vegetable testing and improvement.—This work, which is under the immediate charge of Mr. W. W. Tracy, sr., consists of the trial of varieties of vegetables, the selection and improvement of standard commercial sorts of vegetable seed by line breeding, and in some instances the development of new strains. During the year some 1,200 so-called distinct varieties of vegetables were tested on the Arlington Experimental Farm and the differences developed carefully noted. Similar varietal trials conducted at other places have also been carefully studied and notes taken. The results of these observations may be summarized in the statement that it was found that in a great many cases seedsmen send out under distinct varietal names stocks whose only difference is the degree to which they are uniformly of the same varietal character and that the use of different varietal names to distinguish what are in reality simply different grades or strains of the same sort is a very common practice of even our best and most reliable seed firms.

Seeds used in the Congressional Seed Distribution were tested and found to be in general quite equal in varietal character to those commonly used by seedsmen for their retail trade.

Variation in garden vegetables.—Varieties of vegetables have been studied to ascertain their correlation and practical value in adapting the varying forms to different climatic, cultural, and market conditions, and work aiming at the securing of more full, accurate, and comprehensible reports of varietal tests made at various experimental stations and elsewhere was continued with encouraging results.

Experiments to produce seed which would develop into plants of greater uniformity of varietal character were conducted during the year with good progress, particularly in the case of cabbage, though as yet no seed is available for distribution. The work done confirms the belief that marked uniformity of type follows from systematic line breeding and selection. The increased commercial importance of more uniform strains of cabbage is evident when we consider that some of the stocks now used by market gardeners and truck farmers will not produce under ordinary cultural conditions more than 50 per cent of merchantable heads during the period when they can be most profitably marketed, while by more careful breeding it is possible to produce seed which will mature from 90 to 95 per cent during the same period.

Sweet corn.—Seed trials have been conducted to ascertain how far the character of sweet corn is affected by the climate and soil conditions where the seed was grown. In this work seed originally of the same stock but which had been grown for four generations on each locality was planted at Columbia, Mo., Waterloo, Nebr., St. Paul, Minn., Hockanum, Conn., and the Arlington Experimental Farm, Virginia. A study of these plantings showed that the most noticeable results were the superiority in the commercial value of the corn from seed grown in the locality to that from seed grown elsewhere; also, that the corn from seed grown on rich, moist soils like that of the Platte River bottom at Waterloo, Nebr., or that near Columbia, Mo., was a little coarser in grain than that from seed grown on better drained, less nitrogenous soils like those commonly found in Connecticut. The work is being continued the present season.

POMOLOGICAL INVESTIGATIONS.

The pomological work of the Bureau has been continued along the same general lines as set forth in previous reports, with such minor modifications as the needs of the fruit industry of the country have seemed to demand.

POMOLOGICAL COLLECTIONS.

The work having to do with the maintenance of the pomological collections, the revision of fruit nomenclature, and the identification and description of fruits has, as heretofore, been in charge of Col. G. B. Brackett, Pomologist. Information has been furnished to fruit growers with reference to proper locations for orchard sites and other matters pertaining to fruit culture.

Revision of fruit nomenclature.—During the year the revision of the Catalogue of Fruits has been completed. This catalogue consists of a list of fruits recommended for cultivation in the various sections of the United States, and is the result of about 2,000 inquiries sent out to practical fruit growers who have tested these fruits in the various fruit districts of the country. This list can not fail to be of value to the planter who wishes reliable information as to what fruits will probably succeed in the soil and climate where he is located. This is the third revision of the catalogue which has been made necessary in consequence of the rapid development of the country, as well as of the greater number of varieties now cultivated and the great expansion of the fruit industry.

A bulletin entitled "Nomenclature of the Peach" is well under way, being the third bulletin in the series now represented by those on the nomenclature of the apple and of the pear. In this series it is hoped ultimately to publish the names of all cultivated fruits. During the past year considerable attention has been paid to the correcting of erroneous names of fruits. Often one variety is found under a number of different names, and such a state of affairs is misleading. The avoidance of this duplication of names for the same variety is one of the chief objects of this work.

Identification of fruits.—During the last fiscal year 2,725 packages of fruit were received, of which 947 varieties were for identification. Many of these are promising new fruits which may prove to be of considerable value. Of the most promising varieties 444 paintings were made, in order to place the varieties on record. Descriptions of 601 varieties have been made and 106 models secured for record. During the year 547 pomological specimens were added to the collections.

Cooperative orchard on the Arlington Experimental Farm.—The cooperative fruit variety orchard now consists of 25 acres, and new varieties are being added from year to year. This orchard forms an invaluable check list for pomological investigations, enabling the rendering of decisions in regard to quality, appearance, and behavior of varieties and making possible the prediction of the adaptability of these fruits to similar conditions of soil and climate. Fruit seeds, scions, and plants of 20 species, embracing 194 varieties, were received at this office during the past year. These were distributed among 5 of the state experiment stations and to more than 50 careful experimenters. Several varieties of blight-proof pears have been segregated and scions for experimental purposes have been placed with several of the state stations.

FIELD INVESTIGATIONS IN POMOLOGY.

The investigations of problems affecting the culture, marketing, transportation, and storage of fruits, most of which require experimental research and demonstration in the field, have continued under the direction of Messrs. William A. Taylor and G. Harold Powell, Pomologists in Charge. The work has had a steady growth and development, mainly along lines described in previous years, with such incidental modifications as new problems or new conditions not previously encountered have made necessary.

FRUIT MARKETING.

The fruit-marketing investigations have been conducted by Mr. Taylor, assisted by Mr. Powell and Messrs. L. S. Tenny, G. W. Hosford, H. M. White, and, during portions of the year, H. J. Eustace, C. S. Pomeroy, and A. W. McKay.

Improved apple-crop conditions in 1908.—In sharp contrast with the unsatisfactory outcome of the apple season of 1907, the crop of 1908, though rather light as a whole, averaged of such high grade and quality that the prices realized, both in domestic and foreign markets, yielded excellent returns to both the growers and the dealers who handled the crop. Unfortunately the yield was very uneven and the fruit growers, in some important districts where the crop was practically destroyed by untimely spring frosts, were unable to share in the financial returns derived from the crop. Under the recognized light crop conditions that prevailed early in the season more careful preparation was made for the marketing of the crop than has frequently been the case. The growing realization among apple growers that the profitable disposition of their product necessitates at least a reasonable degree of cooperation on their part is gradually bringing about a unanimity of action in the marketing of the crop of certain important apple districts which is having a distinctly beneficial effect upon prices and markets. That there is still a wide margin between the price received by the grower who sells in the fall and that paid by the retailer, who finally distributes the crop to consumers, is indicated by the fact that the selling value of the apples in storage in the United States on January 1, 1909, was practically double the value of the same fruit when it entered storage less than three months earlier.

The need of uniformity in packages and in grade standards becomes annually more conspicuous in the apple trade and is receiving more careful consideration than ever before by organizations of growers and dealers in various parts of the country. Such uniformity would undoubtedly operate to the benefit of all legitimate interests.

Cooperative fruit marketing.—Special attention has been given during the year to the subject of cooperative marketing organizations, with a view to ascertaining the points in the various types that have proved most effective in overcoming recognized difficulties in the handling of fruits, both at home and abroad, Mr. Powell having investigated the working of certain cooperative marketing organizations in Europe in the autumn of 1908. The success of cooperative methods of handling and marketing fruits in several parts of the country, especially on the Pacific coast, has greatly stimulated interest in that direction elsewhere. During the year a cooperative organization for distributing the peach crop of Georgia and adjacent States has been formed and put into operation, while the citrus-fruit growers of Florida, influenced largely by the needs pointed out through the Bureau work on the handling of oranges in that State and in California, are preparing to handle the next crop on a cooperative basis.

Miscellaneous work.—Addresses on topics connected with the work were made before various national, state, and local organizations during the year by Messrs. Taylor, Powell, and Tenny. A bulletin on the Italian lemon industry, in which are included the cultural, marketing, and transportation methods practiced in the handling of this fruit in that country as observed by Mr. Powell during an investigation there in the autumn of 1908 and a description of the methods of preparing by-products of the lemon in that country, by Mr. E. M. Chace, of the Bureau of Chemistry, has been published.

Investigations of the practicability of developing profitable fruit by-products from apples, peaches, strawberries, blackberries, currants, avocados, and pineapples have been prosecuted in cooperation with Mr. H. C. Gore, of the Division of Foods of the Bureau of Chemistry, the results of which are to be published by that Bureau. Investigation of the saki treatment of Japanese persimmons has been continued and some similar work on the cultivated varieties of the American persimmon has been done, though the results of the latter are thus far largely negative in so far as the removing of astringence in advance of the softening of the fruit is concerned.

FRUIT TRANSPORTATION AND STORAGE.

The investigations of the transportation and storage of fruits have been conducted during the past year, as heretofore, by Mr. Powell, assisted by Messrs. A. V. Stubenrauch, L. S. Tenny, S. J. Dennis, G. W. Hosford, H. M. White, C. S. Pomeroy, A. W. McKay, A. D. Shamel, and J. F. Fernald.

California orange work.—The California orange-handling work was brought to a close after an investigation of the influence on their keeping quality of the methods of handling oranges in Tulare County. This region is 200 miles north of the southern California citrus district. It was found by Mr. Pomeroy that rough mechanical handling in the groves and packing houses causes practically all of the losses from decay. More than 2,000 carloads were shipped from this district. The Bureau's work has already had a far-reaching effect in the simplification of the equipment of packing houses and in improving the methods of handling the fruit.

California lemon work.—An investigation was begun in the fall of 1908 of the influence on its keeping quality of the methods of handling the lemon in the field and in the curing and the storage houses and of preparing it for shipment and for the market. This work was conducted in the principal lemon-growing districts from Santa Barbara to San Diego. It has been found that the blue-mold decay, which causes heavy losses in curing and in transit, is due to improper methods of picking, of washing, of grading, and of packing the fruit for shipment. It is due principally to mechanical injury in picking and in grading and packing the fruit. In every house in which the decay has been serious it has been reduced by more careful handling methods.

This work has the support of the entire lemon-growing industry, and it is already having a wide influence in developing better handling methods. A paper prepared by Mr. Powell for the 1907 Yearbook on " The Status of the American Lemon Industry " became available for distribution in the form of reprints early in the year.

Florida orange work.—The Florida orange-decay investigations were continued by Mr. Tenny, assisted by Messrs. White and McKay. The results of the investigation continue to show that the heavy losses in Florida oranges can be reduced by more careful handling methods. During the winter a delegation of 40 Florida citrus growers or warehousemen studied the influence of the Bureau's work on the industry in California, and as a result of the work of Mr. Tenny and his associates and of their trip to California a rapid remodeling of the Florida packing houses and equipment is taking place, and better handling methods will be put into operation during the coming season. A circular entitled " The Decay of Florida Oranges while in Transit and on the Market," in which the results of the work up to December, 1908, were summarized, was issued early in the winter for the information of Florida orange growers.

Grape-transportation investigations.—During the fall of 1908 an investigation was begun of the influence of the methods of handling grapes in California in the fields and in the packing houses on the decay and deterioration of the fruit while in transit. The work was under the direction of Mr. Stubenrauch, assisted by Messrs. Hosford, Pomeroy, and McKay. Ten carloads of grapes, in which part of the fruit in each car was handled in different ways in California, packed in different ways, and shipped at different periods after packing, were shipped to New York and the decay determined on arrival and at different intervals thereafter. In brief, the results show that mechanical injury is at the bottom of most of the decay, that sound grapes decay least, and that the use of a filler in the package, such as cork or redwood sawdust, improves the shipping and keeping quality. This work aims to improve the methods of handling the grape and to devise methods by which the rapidly increasing crop can be distributed over wider areas and over a longer period of time. A circular entitled "Factors Affecting the Keeping Quality of Table Grapes while in Transit and in Storage," in which the experience in the grape work to date was summarized, was issued in August, 1908.

Precooling investigations.—The precooling work has been conducted by Mr. Dennis, assisted by Mr. Fernald. During the year a refrigerating plant designed by Mr. Dennis was installed in a specially built car. The object of the car is to furnish facilities for the technical precooling studies of the Bureau. These facilities are seldom available where the investigations need to be conducted. The car can be moved to any part of the country and carloads of fruit can be refrigerated in a building alongside the car, or a loaded car can be quickly cooled by blowing cold air from the coil room of the refrigerator car either to the room or through the car loaded with produce. The car has been located at Riverside, Cal., since April, where an investigation of the effect of cooling oranges at different temperatures and at different degrees of rapidity is under way.

The precooling investigations of the Bureau are revolutionizing the methods of shipping fruits in some parts of the country. The transcontinental railroads running out of southern California are constructing precooling plants where trainloads of fruit can be quickly cooled after loading. The work has shown that the area of distribution can be widened by cooling fruits quickly after picking, that the ripening processes and decays can be checked, that the freight-carrying capacity of a car can be increased by loading the packages closer together, and that there may be a saving of ice in the precooled cars. These investigations have the hearty cooperation of the fruit-shipping interests and of the transportation companies.

Miscellaneous work.—Addresses on the transportation and storage work as a whole or on special phases of it were delivered before various national, state, and local organizations by Messrs. Powell, Tenny, Stubenrauch, Dennis, and Hosford during the year. As one of the official delegates of the United States, Mr. Powell attended the First International Congress of the Refrigerating Industries, which convened in Paris in October, 1908, where he presented a paper on "The Extension of Markets through Improvements in the Handling and in the Refrigeration of Horticultural Products." The apple and citrus-fruit storage work in California has been conducted along lines similar to those of preceding years.

VITICULTURAL INVESTIGATIONS.

The general work relating to the grape industry has continued in charge of Mr. George C. Husmann, Pomologist, assisted on the Pacific coast by Mr. Fred L. Husmann and, during a portion of the year, by Mr. Alfred Tournier.

Rotundifolia investigations.—In the work with Rotundifolia grapes, 1,030 seedlings were grown on the Arlington Experimental Farm from 3,241 seeds obtained in pollination experiments of the preceding year. These, as well as plants grown from cuttings of 23 promising Rotundifolia and Munsoniana varieties located in field surveys and to be grown for comparison and study, were added to plantings previously made in the cooperative vineyard on the Pender Farm of the North Carolina Department of Agriculture, at Willard, N. C., where nursery work in connection with these species is also carried on. The pruning experiments at the Medoc vineyards, near Enfield, N. C., and at Ronnoc Grove, near New Smyrna, Fla., have been continued. These not only show that Rotundifolia varieties endure pruning well but also that they are benefited thereby, both size and quality of fruit being improved.

In cooperation with Mr. H. C. Gore, of the Bureau of Chemistry, some tests of the availability of varieties of this species for utilization in the form of unfermented grape juice were made, James, Mish, and Scuppernong being the varieties tested. Interesting data on chemical composition, color, and flavor were obtained, but further work along this line appears necessary before conclusions can be drawn.

Grape experiments at Vineland, N. J.—The Vineland experimental vineyard now consists of 9½ acres planted to 59 American grape varieties, 17 of which were added in the spring of 1909. This vineyard is in an exceptionally flourishing condition. The fertilizer experiments have been continued in cooperation with the New Jersey Agricultural Experiment Station, and the pruning, training, and spraying experiments conducted jointly by Mr. Husmann and Dr. C. L. Shear, of the Office of Fruit-Disease Investigations, have also been continued on the farm of the New Jersey Training School for the Feeble Minded. These have shown that some remarkable results are possible in the renovation of old run-down Concord vines through proper methods and care, the yield being increased and the quality of the fruit improved. As a result of the viticultural investigations at Vineland a considerable acreage of new vineyards has been planted in that vicinity.

California grape investigations.—To ascertain the behavior and value of different resistant stocks of 63 additional table-grape varieties that have been introduced in recent years, that number were bench-grafted on selected stocks and planted in the nursery at the Oakville vineyard. Cuttings of 172 resistant varieties from the experimental vineyards, the relative rooting qualities of which it is desired to ascertain, and cuttings of a number of varieties from other sources were also planted in the nursery at Oakville. The cooperative experimental vineyards in California, at Oakville, Fresno, Lodi, Colfax, and Cucamonga, now contain 415 Vinifera and 277 resistant varieties, with 271 Vinifera varieties grafted on resistant stocks.

Cooperators in various parts of the country have been supplied with cuttings and rooted vines of these varieties for trial.

Observations on the phylloxera injury resulting from systematic inoculations with insects on the roots of vines of the resistant varieties at the Oakville and Fresno experimental vineyards were made. Interesting results are being obtained and conclusions reached on the value of grape varieties for various purposes, as, for instance, the congeniality between and the relative behavior and value of Vinifera varieties on different resistant stocks, the adaptability of resistant and other varieties to soil types, and the use and fruitfulness of Vinifera varieties not heretofore grown in California.

FRUIT-DISTRICT INVESTIGATIONS.

The investigations having to do with the adaptability of fruit varieties to various sections have continued in charge of Mr. H. P. Gould, Pomologist, assisted by Mr. W. F. Fletcher.

Adaptability of fruit varieties.—The field work of several years in the eastern mountain and Piedmont regions was summarized and published during the year in the form of a Bureau bulletin, entitled "Orchard Fruits in the Piedmont and Blue Ridge Regions of Virginia and the South Atlantic States." The work in the Ozark region of Missouri, Arkansas, and Oklahoma, which has been given special attention for several years, was somewhat interfered with last season on account of crop conditions, but some progress was made and investigations extended into new territory, particularly south of the Arkansas River in Arkansas. It is hoped that another season's work will complete the field observations in this region.

Early apples.—Field work on the adaptability of early apples to southern New Jersey and the Middle Atlantic States was completed during the past year, and the results are nearly ready for publication in bulletin form. The growth of the early apple industry with relation to its importance in those sections, the cultural conditions, and the relative value and behavior of a large number of early varieties are subjects which will be covered in the report of these investigations.

Dry-land fruit garden.—The cooperative work with the Office of Dry-Land Agriculture has made good progress. Most of the fruits planted at Akron, Colo., in the spring of 1908 grew well during that season, but there was considerable winterkilling of the tops in the winter of 1908–9. Nearly all of the trees, however, have thrown up sprouts, which it is hoped will survive. Owing to unfavorable conditions a large portion of the small fruits planted in 1908 failed to grow. During the past spring the plantings at the garden have been increased, and several kinds of trees were also planted for windbreaks. A few dry-land orchards in the Great Plains were visited for the purpose of securing such information as might be of use on this project.

Cooperative work with the Forest Service.—During the past year arrangements have been made for the establishment of fruit and ornamental gardens near the rangers' cabins on the various national forests. This work is to be conducted cooperatively with the Forest

Service, and its object is threefold. From the standpoint of the Forest Service the aim is to make it possible for the forest rangers to grow sufficient fruit for their own use, which in the majority of cases would be otherwise unobtainable, and to make their surroundings more attractive by the planting of shrubbery or other ornamental plants. From the standpoint of the Bureau of Plant Industry the effort is primarily a study of the adaptability of fruit varieties and ornamental plants. The ranger stations tentatively selected offer a very wide range of climatic and other conditions not represented in present orchard locations. It is expected that the data afforded by such plantings as may be made will greatly extend present knowledge regarding the range of adaptability of the varieties selected for planting. The fruit trees for the first plantings are being grown on the Arlington Experimental Farm from carefully selected stock of representative varieties adapted to a wide range of climatic conditions.

MISCELLANEOUS INVESTIGATIONS.

In addition to the definite lines of work described the Office of Field Investigations in Pomology is giving attention to various special problems related to fruit culture.

Pecan investigations.—The study of the adaptability of pecan varieties has been continued by Mr. Taylor, assisted by Mr. C. A. Reed, and an effort has been made to locate the more important seedling and grafted orchards of this nut throughout the country. Through a circular of inquiry and return card sent out to pecan growers during the year, orchards containing a total of about 300,000 pecan trees have been definitely located, of which more than 200,000 are budded or grafted trees of named varieties. Of the remainder about 40,000 are reported to be seedlings of known parentage and 45,000 seedlings of unknown ancestry. Orchards of bearing age, whether consisting of budded or grafted trees or of seedlings, are being visited during the fruiting season so far as possible, with a view to determining the relative adaptability of the varieties in them to the varied conditions found in the South Atlantic and Gulf States, information on this point being at the present time probably the greatest need of the pecan industry.

Experimental studies of self-sterility of varieties have been continued at Orange Heights, Fla., and Dewitt, Ga., and tests of the cracking quality of varieties, including determinations of proportional weights of kernel and shell of leading varieties, have been made. Descriptions and colored-plate illustrations of five additional promising varieties of pecans (Bolton, Carman, Hodge, Kennedy, and Taylor) were published in the Yearbook of the Department for 1908, making a total of 30 varieties of this nut thus described and illustrated in the Yearbooks since 1904.

Cooperative fruit breeding.—In recognition of the importance of developing hardier orchard fruits of better quality than are yet available, with special reference to the needs of the upper Mississippi and Missouri valley regions, a cooperative arrangement has been made with Mr. C. G. Patten, of Charles City, Iowa, with the Iowa Agricultural Experiment Station, and with the Iowa State Horticultural Society through which the work along this line, long privately prosecuted by Mr. Patten, is made a public matter in the interest of the fruit industry of those regions. This work is located at Charles City, Iowa, under the joint supervision of this Bureau and the Iowa experiment station, and all varieties produced that promise to be of value are to remain public property and to be available for dissemination in due time.

PLANS FOR FUTURE WORK.

The pomological investigations of the ensuing fiscal year will continue along the same general lines as heretofore. Several new projects will be undertaken or developed, while others approaching completion will be closed.

FRUIT MARKETING, TRANSPORTATION, AND STORAGE.—These closely allied lines will be carried forward on much the same basis as during the past year. More attention will be paid to the lemon work in California than to that on the orange in that State, the present need of the lemon industry being much greater than that of the orange industry, in which the results of the Bureau's work are now quite generally accepted, many of the reforms worked out by the Bureau being already adopted in practice by a considerable proportion of the industry. The cooperative organization of the peach growers of Georgia and the citrus growers of Florida should make possible more effective application of the principles of careful handling that have already been worked out than has hitherto been possible in those States. Packing-house experiments and demonstrations and experimental shipments will be made in this work.

The storage investigations on California apples and grapes will be continued, and the precooling of grapes and oranges for experimental shipment will be continued in that State during the fall and winter. It is expected that systematic precooling of peaches in Georgia can be undertaken with the portable plant of the Department which is now in service if the crop conditions are favorable in the season of 1910. Cooperative work on fruit juices and other by-products will be continued with the Bureau of Chemistry.

VITICULTURAL INVESTIGATIONS.—It is the intention to continue the grape investigations now under way, many of which require several years for their solution, and to take up such additional work as may be necessary. In cooperation with the Bureau of Chemistry analyses of the fruit and juices of certain Rotundifolia and Labrusca grape varieties are to be made. The experiments at Vineland, N. J., in renovating and making profitable old Concord vines will be continued. Extensive pruning and training experiments are to be started in the Vineland experimental vineyard and in the Rotundifolia vineyard at Willard, N. C. The fertilizer experiments in cooperation with the New Jersey Agricultural Experiment Station will be continued.

FRUIT-DISTRICT INVESTIGATIONS.—The fruit-district and phenological projects will continue to be major lines of work. In connection with the first mentioned, systematic investigations of the adaptability of fruit varieties are to be carried on in Oklahoma west of the Ozark formation and east of the dry-plains area and in the corresponding portions of Kansas and southeastern Nebraska. A small amount of time will be spent in the Ozark region in completing the work which has been in progress there for several years. More extended observations will also be made in the dry-land orchards of eastern Colorado. The Panhandle region of Texas is also to be visited in this connection.

The phenological work will progress along the usual lines with such extension as is practicable. The forest ranger fruit gardens will probably make good progress, as it is expected that the nursery stock now being grown for use in these gardens will be ready for planting at some of the ranger stations next spring.

Miscellaneous investigations.—The studies of varietal adaptability and self-sterility of pecans will be prosecuted to the fullest extent that the time and funds available will permit, and storage tests of leading varieties will be undertaken. The hardy fruit breeding work will be continued as during the past year. Work on citrus-fruit improvement will be undertaken by Mr. A. D. Shamel in California on a well-considered plan of bud selection based on records of regularity and volume of crop, size, appearance, and quality of the fruit, endurance of adverse temperatures, and resistance to injurious insects and diseases. The need of work along this line on oranges, lemons, and pomelos has become conspicuously apparent.

GREENHOUSES, GARDENS, AND GROUNDS.

The general work connected with the maintenance of the Department grounds and the care and operation of the greenhouses has continued in charge of Mr. E. M. Byrnes. The experiments in the hybridization and propagation of plants have been conducted, as heretofore, by Mr. George W. Oliver.

GENERAL WORK OF MAINTENANCE AND OPERATION.

In connection with the greenhouse work there were propagated and distributed during the past year 159,435 plants, representing 86 species and varieties. This number is considerably in excess of that of the preceding year.

Necessary construction and repairs.—A brick building 122 feet 8 inches by 155 feet 10 inches and two stories in height was constructed on the north front of the Department grounds to accommodate the Department shops and stables, and a brick vault 15 feet 8 inches square was built near the northeast corner of the grounds to be used for storing chemicals. A 6-inch steam main was laid from the new central heating plant on B street SW. and connected with the pipes heating the greenhouses at Fourteenth and B streets NW. and with the new building used for shops and stables, at Thirteenth and B streets NW. The old brick stable and the large frame storage shed which stood between the new wings of the Department building and a large brick and frame building used for workshops near the west end of the administrative building were torn down and removed. Two new greenhouses, each 20 feet wide, 142 feet 6 inches long, and 14 feet high, were constructed on the north front of the Department grounds east of the present range of greenhouses at a cost of $2,419.90. Such repairs were made to the old greenhouses as were necessary to keep them in a temporarily serviceable condition. Three greenhouses were given a coat of paint both inside and outside.

GREENHOUSE WORK AND OPERATIONS.—In the new range of greenhouses there are 18 houses which are devoted to the following work: The propagation of plants and fruits secured by the Office of Foreign Seed and Plant Introduction; the hybridization of plants; seed testing; drug-plant and tea-culture investigations; experimental work in vegetable physiology and pathology; the propagation of plants for ornamenting the Department grounds, including the grounds of the Weather Bureau, and for distribution; and experimental work with florists' crops, vegetables, and other greenhouse crops. In connection with the floricultural work the following plants were grown: 1,702 roses in 12 varieties; 5,615 carnations in 12 commercial varieties, as well as 800 seedling plants resulting from crosses made during the past winter, and 2,500 chrysanthemums in 378 varieties, together with 560 seedling plants which are the result of crosses made last autumn. The chrysanthemums were grown for our annual show, which was opened to the public on the morning of October 28, 1908, and was closed on November 4. Great interest is manifested by the public in these shows, not only in Washington, D. C., but at other points. According to our custom the flowers after the close of the exhibition were cut and distributed to all of the hospitals in the city.

Five of the six greenhouses in the old range are devoted to experimental work in vegetable physiology and pathology and to a collection of tropical plants, while one small house and a section of another have been allotted to the normal schools of Washington, D. C., for school-garden and nature-study work.

GENERAL IMPROVEMENTS IN THE DEPARTMENT GROUNDS.—The ground on the south, east, and west fronts of the wings of the new Department building was graded and seeded in grass; 639 square yards of cement pavements and 1,300 square yards of macadam roads were laid at the entrances to the wings; the south side of the grounds was inclosed with 651 linear feet of galvanized-iron pipe fence; 969 square yards of asphalt roads and walks were repaired and resurfaced; and the macadam roads constructed two years ago were resurfaced with 100 tons of trap rock screenings. During the season the lawns were mowed and the edges trimmed as often as was required to maintain them in good condition, the asphalt roads and walks were swept and cleaned daily, and the macadam roads were watered daily during dry weather. Dead branches were removed from the trees and shrubs, and three dead trees were removed from the grounds. The shrubs and hedges were pruned as often as was required, the walks and roads were kept free from weed growth, and the lawns were dressed with 6 tons of fertilizer, bare spaces being forked and seeded in grass.

ORNAMENTAL PLANTINGS IN THE GROUNDS.—During the year 12 young ornamental deciduous trees and 287 deciduous and herbaceous shrubs were added to the collection in the grounds, and 227 hardy vines were planted to cover buildings and fences. A collection of 10,432 standard sorts of hyacinth, tulip, and narcissus bulbs and

4,600 pansy plants was planted in the beds in the autumn for display in the early spring, and a collection of 20,329 bedding plants in 57 species and varieties and 560 tropical plants in 30 species and varieties was planted in beds in the spring. In the trial grounds a collection of hybrid grasses and cowpeas was planted for testing.

Plans for the ensuing fiscal year.—It is proposed during the ensuing fiscal year to build six greenhouses, each 100 feet long, 20 feet wide, and 14 feet high; to build a frame shed on brick foundation, 155 feet long and 16 feet wide; to give a coat of paint to eleven greenhouses, both inside and outside; and to remove the old range of greenhouses on the north front of the west wing of the new Department building, grade the ground, and seed it in grass. The experimental work with florists' crops and vegetables, together with the propagation of trees, plants, and shrubs, will be continued along the same lines as last year.

HYBRIDIZATION AND PROPAGATION OF PLANTS.

The work of improving plants by hybridization and of developing improved methods of propagation has been continued by Mr. George W. Oliver, Expert, and good progress has been made along a number of lines.

New lettuce for forcing.—The largest headed forcing lettuce among the crosses made a few years ago has been bred to come true to type. During the coming season seeds of this lettuce will be ready for distribution, and it is believed that it will prove of great value.

New cowpea hybrids.—In order to produce ideal cowpeas for the various sections of the country many crosses have been secured during the past year, and several of those made during preceding years are being grown for fixation. Some promising forms have already been secured and are being given a thorough trial.

Hybrid alfalfas and grasses.—Two of the new alfalfas (*Medicago falcata* and *M. ruthenica*) secured by Prof. N. E. Hansen in Siberia have been crossed with the hardiest forms of *Medicago sativa*. These plants are to be tested in the coldest parts of the United States. The second generation of hybrids between *Poa arachnifera* and *Poa pratensis* made very satisfactory growth the past summer, notwithstanding the dry season.

Establishment of Easter-lily production.—The work of establishing the production of Easter-lily bulbs in the United States is proceeding satisfactorily. About 60 quarts of seed resulted from cross-pollinating the flowers of the best varieties grown in the Department greenhouses. This seed gave a high percentage of germination during the autumn of 1908. The seedlings were planted out during the spring of 1909, one firm cooperating with the Department having planted 8 acres, on which the seedlings are reported to be very vigorous. If conditions are satisfactory these plants will reach their maximum size this season. The future success of this work now depends upon alternation of crops to guard against the attacks of mites. Some of the varieties developed by cross-pollination are much more vigorous than the older established varieties.

Hybrid chrysanthemums and dahlias.—Two of the wild species of chrysanthemum have been secured from China during the past year. These are now being grown for the purpose of crossing with some of the best varieties now in cultivation, the object being to produce satisfactory varieties for outdoor growth, especially in the colder parts of the country. By the use of recent discoveries in the technique of plant breeding this result is easy of accomplishment. Seeds of the new hybrid dahlias have been given a wide distribution during the past year to test their value. Some of the best of the plants have been propagated from cuttings, and these will be distributed next spring.

Raising new hardy roses by hybridization.—One of the new roses secured by Mr. Frank N. Meyer, Agricultural Explorer, has bloomed and proves to be a new double yellow briar which comes in flower by the end of April in the District of Columbia. This has been crossed on white seedlings of Rugosa, and several hybrids have been secured. Other plants of Mr. Meyer's introduction will probably bloom the coming season.

New method of propagating plants.—The propagation of hardwooded plants by the seedling method of inarching continues to be increasingly useful. It is now possible to inarch the rarer kinds of fruit trees, such as the mango and leitchee, in much less time and with greater certainty than by the old methods. Where young shoots of the mango, for instance, are available in large quantities this work can be done with profit to the operator by selling them for less than 20 cents each, instead of from $2 to $5 each, as heretofore. The method, furthermore, is not one that requires any great amount of skill. An intelligent school boy could be taught to operate it successfully in fifteen minutes. The Bureau has introduced nearly 100 of the finer varieties of the mango from India and elsewhere, and these have been propagated in the Department greenhouses and given a wide distribution. Any grower can now increase the number of his plants to any extent. A bulletin on the subject giving full instructions has been prepared.

New methods of plant breeding.—Some far-reaching changes in the methods of manipulating flowers preparatory to pollination have been developed. These methods are particularly adapted to the more difficult subjects, and a pamphlet describing them is now in the hands of the printer.

WORK RELATING TO THE PURCHASE AND DISTRIBUTION OF SEEDS.

The various lines of work connected with the carrying out of the seed distribution and the introduction of seeds and plants from foreign countries have continued along the same general lines as heretofore.

FOREIGN SEED AND PLANT INTRODUCTION.

During the past year the work of introducing foreign plants for the use of the official and private experimenters throughout the country has, as in previous years, been in charge of Mr. David Fairchild, Agricultural Explorer. The explorations in foreign countries have been conducted by Mr. Frank N. Meyer and Prof. N. E. Hansen, while special barley investigations have been conducted by Dr. Albert Mann.

Biweekly bulletin of importations.—In order to meet the increasing demand for new introductions of an experimental character and at the same time to interest a wider range of experimenters, it has been found necessary to issue a biweekly bulletin of information regarding the new things imported. The call for this bulletin has been so great that it has been necessary to confine its circulation to official experimenters of the state experiment stations and a few of the most experienced private experimenters of the country, in order not to be flooded with requests for material of which only small amounts have been obtained.

Plants secured through correspondence.—The requests for foreign plant material have increased so rapidly that it has become necessary to extend into all parts of the world the network of correspondents who can secure the many types of wild and cultivated plants that are desired. As the number of trained plant experts in remote parts of the world is small, it has required a large amount of correspondence to get in touch with the best of them. Over 2,000 selected seeds and plants were secured in this way last year and distributed to the experimenters of the country. A few of those which may have a direct bearing on the improvement of our staple crops or lead directly to the starting of new industries may be mentioned. A collection of 72 varieties of potatoes, including wild forms from the southernmost province of Chile, a region where it is reported that the potato rot is quite unknown, has been secured. These are for the specialists who believe that new blood is needed to improve this crop and create dry-region forms. Varieties of alfalfa from Peru, Australia, Spain, and Chile for trial as to drought resistance, cold resistance, and ability to grow in the mild winters of the Southwest; a number of new varieties of table grapes of excellent quality from Bagdad, Arabia, whose possibilities for California are being tested; new cereals from high altitudes in central China; a collection of forage and grain crop seeds from the highlands of Abyssinia; wild raspberries from the Philippines, India, and the Yangtze Valley; two southern Chinese strains of peaches which are especially desired by southern peach growers; and numerous other seeds and plants of great promise have been secured.

Alfalfas secured in Siberia.—The search for Siberian wild alfalfas which would lead to the creation of hardier races of this remarkable forage plant in the Northwest, where winterkilling of the ordinary alfalfa fields caused the farmers a few years ago such great losses, was carried on by Prof. N. E. Hansen, of the South Dakota Agricultural Experiment Station. Professor Hansen left America in June, 1908, and returned in February, 1909. His previous explorations had made him aware of the presence in the cold, arid regions of central Asia of at least two new alfalfas which, although at the present time not in cultivation, he believed could be domesticated and which would prove perfectly hardy in the Dakotas. One of these, *Medicago falcata*, had been secured in small quantities by him and tried in plats in the Northwest, but a large quantity of seed was desired. The other species, *Medicago ruthenica*, which Professor Hansen found on the northern edge of the Desert of Gobi, had never been introduced, and owing to the severe climatic conditions under which it seemed to thrive and form an important element of the wild pastures he predicts that it will be a very valuable addition to the forage plants of the Northwest, either in cultivation or when allowed to grow wild on the ranges. Both forms, indeed, he thinks may be adapted to disseminate themselves over the northwestern ranges and add valuable leguminous forage elements which will be able to withstand greater extremes of cold and drought than the native forage plants.

In addition to these dry-land alfalfas, Professor Hansen found, in the open places along the edges of timber, a third species, *Medicago platycarpa*, which he advises should be tried in sheltered regions in Minnesota and Wisconsin, and also five species of clover which have been little experimented with in this country. A report on the wild alfalfas of the region he explored has been published. All of the new varieties are being given a thorough trial.

Report on the agriculture of China.—Mr. Frank N. Meyer, who returned from a three years' exploration of China and Manchuria on July 1, 1908, has been engaged during the past year in the preparation of an extensive report on the agriculture of northern and central China and in arranging for his next expedition into the region lying between Tashkent and the unexplored portions of Chinese Turkestan, where he is going to search for hardy wild apples, pears, plums, apricots, peaches, grapes, and other fruit and comfort plants which have been requested by the plant breeders of the upper Mississippi Valley, as well as for hardy, high-altitude grains and drought-resistant forage plants the existence of which has been traced in the literature of the region.

The agriculture of China is little known to American farmers and fruit growers, and Mr. Meyer's report embodies his personal observations of present conditions among the Chinese. It is the first serious attempt of a trained agricultural explorer who is familiar with American conditions to give an accurate account of the practices of the Chinese farmers and fruit growers. The lessons which this ancient agriculture has for Americans are of the greatest importance, especially those relating to the disastrous consequences of an indiscriminate deforestation, the conservation of the fertility of the soil, the utilization of alkali lands, the dry-land practices, and the employment of crops with which we are not acquainted for the solution of problems which have begun to confront us in America.

Bamboo investigations.—Three thousand bamboo plants of the hardier timber kinds have been landed from Japan during the past year, and a large proportion of them are now successfully growing in the Plant Introduction Garden at Chico, Cal., and on the estate of Mr. William E. Tevis, of Bakersfield, Cal. The problem of quick, cheap propagation of these tall-growing species is being worked out, as one of the chief expenses lies in the transportation of the heavy clumps which are now used by Orientals in starting their groves. The use of much smaller plants may not only reduce the freight expenses, but increase the chances of their successful culture.

After a thorough investigation in the Southern States it has been decided to accept an offer of 20 acres of land near Brooksville, Fla., and to establish there the first experimental grove of timber bamboos in this country. The bulk of the plants now at Chico will be transported there this winter, and the remainder possibly to other points yet to be selected in the South or Southwest. The establishment of a grove is the first step in the problem of bringing the material to the attention of manufacturers, since bamboo timber must be worked up in the green state to develop the greatest variety of uses. Manufacturers must be assured of the possibility of a regular and adequate supply of this unique timber material before they will make machines capable of utilizing it. As a minor matter, but one worthy of serious consideration, will come the possibilities of marketing the fresh young bamboo shoots, which are as highly prized by Europeans in the Orient as is asparagus.

In addition to the large introduction of bamboos from Japan a new Chilean variety has been secured, and forms from the drier portions of India, which are reported to be frost resistant, have been grown from imported seed and distributed by the thousands to test their hardiness.

Special barley investigations.—Dr. Albert Mann's investigations of barley culture in Europe have resulted in impressing upon experimenters in this industry and users of this great grain crop the most important fact that varieties must be bred for the soils on which they are to grow, and his investigations also indicate that we can not expect the best results from the growing of a single variety over a great range of territory diversified in soil and climate. The study of the so-called "new-place effects," to which barley as a self-fertilized plant is especially subjected, will probably make easier the acclimatization of some of the superior races of high-bred barleys in this country by excluding at once territories to which they are unfitted. The experience of foreign barley raisers agrees in the fact that there is little, if any, power of subsequent adaptation in this plant. The European investigations made evident the necessity of somewhat radical changes in American barley culture, especially at the period of harvesting. The greater care and more exact methods universally adopted in the great barley fields of Europe were shown to be one of the chief causes of the undoubted superiority of this crop in these countries as compared to the American product. Especially in matters of the proper rotation of barley with other crops and in its removal from the period of fertilizing the land, as well as in the larger quantity of seed sown so as to produce uniformity of ripening, we have much to learn from the cultivators of the Old World.

The indorsement by European experts of the conclusions reached by Doctor Mann based on the investigations of the scutellum and pointing to the great importance of this organ in increasing the quality of malting barley has made it evident that extensive experiments along this line should be undertaken, and as a result a large part of the work being carried on this year in cooperation with the Minnesota Agricultural Experiment Station has reference to this particular phase of the subject.

China wood-oil investigations.—In 1905 experiments were begun with a view to determining the sections climatically suited to the tree which furnishes the China wood oil, or t'ung oil, of commerce.

These experiments are practically completed and were successful in showing that the section bordering on the Gulf of Mexico as far north as Natchez, Miss., and possibly farther, furnishes its most congenial home. The trees set out have borne sparingly, but no particular attention was paid to choice of soils in these experiments. T'ung oil is already a permanent factor in several American industries. The oil is as yet not thoroughly understood, but it is the quickest drying and hardest oil known, having in addition other desirable properties which give durability and elasticity to articles made from it. It might to a certain extent be compared to linseed oil, of which, however, it is not a competitor, as it contains gummy substances which enable it to displace in varnish and linoleum manufacture the high-priced and rapidly disappearing kauri gums of New Zealand, making in combination with resin a satisfactory substitute. The importations from China already amount to 2,000,000 gallons annually, worth $1,000,000.

It is known that the seeds of the t'ung tree yield about 25 per cent of oil, but it is not known what quantity the tree will produce under favorable conditions. A knowledge of the average price of wood oil and its market conditions and of the difference in freight rates from China and from the wood-oil areas of this country to our manufacturing centers will, when the actual yield per acre and the cost of production are determined, enable us to figure out whether or not it will pay to grow the wood-oil tree in this country. It will therefore be necessary to commence experiments for the purpose of locating those soils giving a satisfactory yield and to determine this yield as accurately as possible. At least five years will, under favorable circumstances, be necessary to solve this problem.

DEVELOPMENT OF THE MANGO INDUSTRY.—Through the distribution of the better fiberless varieties of East Indian mangos, which have been imported from time to time, many of which have come into fruit in Porto Rico, Hawaii, Florida, and Cuba, a lively interest in this most promising subtropical fruit has recently been aroused, and it is reported from Florida that mango growing has reached the stage where it is looked upon as one of the coming industries in the southern part of that State. The demand for the grafted varieties in the possession of the Department is much greater than can be supplied. Special arrangements are being made to encourage a quicker dissemination of the varieties which have proved good yielders and of good quality and to test on a larger scale than heretofore those which have not yet been fruited in this country.

MANGOSTEEN INTRODUCTION.—Since the discovery by Mr. George W. Oliver, of this Bureau, that the mangosteen can be successfully grafted on a related species (*Garcinia xanthochymus*), seeds of the latter have been imported in considerable quantities, and this remarkable fruit plant, which has failed generally in the West Indies because of its poor root system, is now prepared to go out to experimenters on a new and much less exacting stock. This discovery quite changes and increases its chance to succeed in such regions as the Panama Canal Zone, where already several young plants are growing successfully and where it is believed the mangosteen may make its first great success as an orchard plant in the Western Tropics.

Chinese leitchee.—The Chinese leitchee, which is still an unknown fruit in the Western Hemisphere, but one of the best of the oriental fruits, has been grafted on the hardier longan, which has fruited in Florida, and young plants are ready for trial in the subtropical parts of the country. The Javanese species and a species from the Philippines are being secured to complete the trial of these neglected fruits.

Mitsumata paper plant.—The problem of cultivating the Japanese mitsumata paper plant, which has shown itself capable of living in the region about Atlanta, Ga., is still in the experimental stage. The high quality of the paper which can be made from it puts the mitsumata as a paper plant in a class by itself. Samples are under investigation at the present time by the manufacturers of so-called "manila paper," which is said to be made largely from the waste from rope factories. The small planting at Atlanta will be increased this year in order to keep a supply of the fiber on hand pending the discovery of a practicable and profitable use by the paper manufacturers.

Completion of matting-plant experiments.—The matting-plant investigations will be discontinued the coming year on account of the impracticability of American loom manufacturers successfully competing with oriental producers under existing conditions. So far as the experiments of the Department are concerned, they were successful to the point of the cultivation of the Chinese matting sedge in South Carolina, Louisiana, and Texas. Last year a superior grade of matting was made of sedge straw which was grown on the experimental plats in Texas and South Carolina. We were prepared this year to deliver to the splitting machines which the manufacturers agreed to put in the field all the straw they could use. However, as there is little hope under existing conditions for the development of an American matting industry at this time these experiments, which have been a good example of the efficiency of the Department in investigating possible new industries, are being brought to a conclusion.

During the year the investigation of the possibilities of reed-lath matting was also carried to completion. It was found that an unusually satisfactory substitute for lath could be made from the common reeds along our waterways, that this plant would yield a yearly supply of the reeds, and that while a good lath could be produced it would not absorb enough of the moisture of the plaster to enable the double-coat work which is done in the inside construction of cheap houses. The reed lath has some decided advantages over ordinary lath, but owing to increased cost of manufacture and other conditions brought out in the course of the experiments it has been decided to discontinue the work.

California plant-introduction garden.—By means of the Plant-Introduction Garden at Chico, Cal., it has been possible to distribute during the past year over 5,000 plants, representing, among other interesting things, a wild Chinese peach which is in common use in China as a stock for all kinds of stone fruits, but, although having drought-resistant qualities, has not been tried in America; a dry-land elm from near Peking which has unusual drought-resistant qualities and seems well fitted for trial in the Southwest; various new brambles from the Yangtze Valley, some of value for ornamentals and others for breeding purposes; a new Chinese poplar which is believed to rival the Lombardy; a large, edible-fruited hawthorn from Shantung, which Mr. Frank N. Meyer predicts has a future in the dry Southwest for preserving purposes; and the Chinese date, or t'sao, the possibilities of which as a new fruit for the regions in which the jujube now grows are being investigated.

Mississippi Valley plant-introduction garden.—The garden at Ames, Iowa, which was started last year for the purpose of propagating hardy plants secured from northern countries, has prepared for fall distribution a large number of new introductions, particularly from northern China. Coming, as these do, from northeastern Asia, they give promise of being hardy in the northern Mississippi Valley. These should be especially valuable to breeders of hardy fruits in that region, and the comfort plants, such as street trees and ornamental shrubs, should prove of great value to settlers on those parts of the western plains where any but the hardiest of such plants refuse to grow.

FORAGE-CROP INVESTIGATIONS.

During the past year the work with forage crops, under the direction of Prof. C. V. Piper, Agrostologist, has proceeded along the same general lines as in the preceding two years.

ALFALFA.

The work with alfalfa has continued under the immediate charge of Mr. J. M. Westgate, Agronomist. The demands for information from farmers relate largely to the culture of alfalfa in regions where difficulty is experienced in producing successful crops, namely, in the greater part of the region east of the Mississippi River and in the States where severe winter weather destroys the stand.

Alfalfa in the East.—The results of a great deal of cooperative work with farmers, as well as more definite experiments, demonstrate beyond doubt that the principal factors entering into the successful cultivation of alfalfa in the humid sections east of the Mississippi are (1) inoculation, (2) acid soils, (3) drainage, (4) time of seeding, (5) weeds, (6) firm seed bed, and (7) disease. It is safe to say that by care alfalfa can be made to grow on any deep, fairly fertile, well-drained land, provided the soil is not acid, inoculation is provided, and the seed is sown at the proper time on a clean, fairly firm seed bed. Soil acidity can always be corrected by the use of lime. Successful inoculation is rarely secured without the use of soil from a field of alfalfa or sweet clover. Below the southern border of Pennsylvania the alfalfa crop should be sown not earlier than August 15 nor later than September 1. Northward, spring seeding is most successful. In most eastern localities weeds, principally bluegrass in the North and crab-grass in the South, will limit the life of an alfalfa field to three to five years, even with good treatment. Certain poorly understood diseases, as yet not widespread, may destroy the field the second season. The general conclusion at the present time is that all farmers on limestone soils east of the Mississippi should grow alfalfa, while on other types of soil the crop is one for the special farmer, particularly the dairyman.

HARDY ALFALFAS.—Numerous cooperative tests with hardy alfalfas, notably sand lucern and Grimm alfalfa, are still under way. The results to date indicate that the Grimm alfalfa is somewhat hardier than the sand lucern, although in a number of tests sand lucern has proved equal or superior to Grimm alfalfa. The evidence tends to show that there is a considerable variation in the relative hardiness of the different commercial lots of sand lucern purchased from European seed houses, and for that reason it is desirable that seed should be obtained from American fields of demonstrated hardiness. The conclusions reached in the last report relative to the close relationship of these two alfalfas are confirmed by further study.

The Siberian alfalfas secured by Prof. N. E. Hansen, from which much is hoped, are very hardy but possess some handicaps, namely, lack of erectness, low yield of hay, and poor seeding habits. To correct these shortcomings, hybrids have been made with hardy individual plants of ordinary alfalfa, and these show intermediate characteristics between the two species in the first generation.

ARABIAN ALFALFA.—The excellent results thus far obtained in California with Arabian alfalfa have led to a demand for the seed far in excess of the quantity yet obtainable. Arrangements have been made so that further importations of the seed will be sold through reliable firms at reasonable prices. Some evidence is accumulating that the variety is not so long lived as the ordinary alfalfa.

ALFALFA-SEED PRODUCTION.—Experiments with alfalfa in cultivated rows for seed production in the semiarid regions are being conducted in cooperation with the Office of Crop Physiology and Breeding Investigations of this Bureau, and a preliminary bulletin has already been issued. In this work cooperation is also practiced with numerous farmers, as well as with special testing stations. Improved strains selected for heavy seed yielding are giving most gratifying results.

GRASSES.

The grass investigations have been continued by Mr. R. A. Oakley, Assistant Agrostologist, and good progress has been made.

MIXTURES FOR MEADOWS.—Extensive tests have been conducted with meadow mixtures for sections where timothy can not be profitably grown. In this connection most attention has been given to orchard grass, tall oat-grass, and alsike clover as a basis for various combinations. Mixtures of these grasses in different proportions, with meadow fescue, redtop, or in some cases with rye-grasses for bottom grasses, have proved very satisfactory, especially on poor clay soils. These mixtures, in addition to giving profitable yields of hay, enable the farmer to keep his land free from such obnoxious weeds as the oxeye daisy (*Chrysanthemum leucanthemum*) and "whiteweeds," or "white-tops" (*Erigeron annuus* and *E. ramosus*), by reaching the proper stage of maturity for hay before the weeds have set seed. Timothy, unfortunately, is cut for hay after the weeds have become fully mature, permitting them to reseed abundantly. A mixture of orchard grass and tall oat-grass when grown on land for a few years rids it almost completely of weeds.

PASTURE EXPERIMENTS.—Extensive tests of methods of grazing and the general management of pastures are being conducted at Blacksburg, Va., in cooperation with the Virginia Agricultural Experiment Station. Two series of plats are used, the first containing 8 plats of 2½ acres each, treated in various ways and grazed by stock, and the second 10 plats of one-fiftieth acre each, which are treated mechanically and used for making careful observations. The principal objects are to determine the relative values of continuous and of alternate grazing of fields and of heavy, light, and moderate grazing, and to determine the value of cultural treatment. The tests have not been conducted for a sufficient length of time to warrant a definite report of results.

IMPROVEMENT OF GRASSES.—The development of improved strains of timothy and orchard grass by breeding and selection has been continued on a more extensive scale than heretofore. In the summer of 1907 arrangements were made with farmers to test three of the improved strains of timothy originated by Dr. A. D. Hopkins, namely, the Stewart, Hopkins, and Pasture varieties. Results of tests this year have indicated that in some localities at least the Stewart timothy, which was selected for its increased vigor and heavy yielding qualities, is noticeably superior to the ordinary timothy grown. Timothy rust still continues to be an important factor, and all the new strains that are being developed possess rust resistance in addition to their other superior characters. For the facilitating of the timothy-breeding work a special station has been located in north-central Ohio.

Four improved strains of orchard grass, selected for valuable hay and seed producing qualities, have been sown on a field scale, and results of these tests will be available next season. The possibilities of securing strains of orchard grass more valuable for hay and pasture than the common orchard grass are very promising. It is hoped that by this means some of the unwarranted prejudices against orchard grass may be largely overcome.

PARA AND RHODES GRASSES.—Para grass is still being extended in the Gulf coast region and under irrigation in favorable sections of the Southwest. Arrangements are being made to conduct feeding tests of Para-grass hay in comparison with timothy and other standard grasses, especially for livery horses. If it can obtain a standing on the city markets of the South, Para grass will doubtless soon become a popular crop in that section.

One of the most promising new grasses which has recently been tested is Rhodes grass (*Chloris gayana*). This grass is remarkably aggressive in the South and will yield three or more cuttings per season of valuable hay. It is also adapted to the irrigated sections of the Southwest. As soon as sufficient quantities of seed can be secured the grass will be thoroughly tested in large areas.

GRASS-SEED PRODUCTION.—The investigations along the line of grass-seed production have been continued, and a bulletin on meadow fescue, by Mr. H. N. Vinall, has been published. Attention is now being given to the production of seed of redtop, and especially of the fine-leaved species of Agrostis, which are valuable lawn grasses.

SORGHUMS.

Investigations of forage sorghums have been continued by Mr. A. B. Conner, Assistant. The principal work is being done at Chillicothe, Tex. Large quantities of improved selected seed of Blackhull kafir, Red kafir, Dwarf milo, and of Red Amber, Sumac, and Orange sorghums have been grown and distributed. The results of previous distributions have made it possible to map out the approximate area in which each variety grows best. It is proposed in future distributions to send only the best variety to each region and to recommend that no other be grown. Only in this way can sorghum varieties be kept approximately pure, as they cross very rapidly.

Dwarf milo.—For three successive seasons a series of milo plats has been grown at Chillicothe, Tex., to determine the best seeding rate for forage and seed purposes and the relation of thickness of stand to the percentage of erect heads. These plats were planted in rows 3 feet apart and with plants 2, 4, 6, 8, 10, 12, and 16 inches apart in the drill. The results have shown each year that the heaviest yield of forage and seed will be obtained when the stand averages a stalk every 4 to 6 inches. Furthermore, it is shown that stands as thick as or thicker than 6 inches have a very small percentage of pendent heads, indicating that all moisture has been utilized, whereas thinner seedings have a large percentage of pendent heads, with a possible waste of moisture in growing the crop.

Feterita, a new sorghum.—Feterita, a recent valuable sorghum introduction from the Sudan region of Africa, promises to be equal and perhaps superior to milo for grain and forage purposes throughout a great portion of the semiarid Southwest. It grows from 5 to 6 feet high and produces erect heads composed of bluish white seeds larger than those of milo and equally soft. For grain purposes it is exceedingly promising. Its stem is pithy and dry, but sweet, and the plant this season under extreme drought seems to hold its leaves after ripening in much better condition than milo. The plant is about as early in maturing as milo and has every indication of being as resistant to drought. Selections are being made to secure a type that will hold its leaves in good condition long after ripening. This crop is so very promising that it will be supplied at once to experiment stations and to a few carefully chosen farmers in the semiarid regions, where it is likely to prove of most value.

A new grass sorghum.—Botanists and agronomists generally suppose that all of the cultivated sorghums are derived from Johnson grass. The latter is widespread in the South, often grown for hay or pasture, but generally condemned where clean cultivated fields are desired. It would be an extremely valuable grass if it were not for the rootstocks, which make it very difficult to eradicate. It is therefore a matter of great interest that a variety recently obtained from Khartoum, Africa, is absolutely free from rootstocks, but otherwise very similar to Johnson grass. It is hoped that at last the grass has been found that will be to the South what timothy is to the North.

MISCELLANEOUS FORAGE CROPS.

Soy beans.—Through the Office of Foreign Seed and Plant Introduction nearly 300 varieties of soy beans have recently been obtained from China, Japan, and India. The preliminary work of testing the value of these has been conducted at the Arlington Experimental Farm, and this year it is being continued with the cooperation of all the experiment stations that are interested in the crop. Much greater attention than formerly is being given to the soy-bean crop in this country, due in part to a clearer recognition of its merits and in part to the ruling high prices of concentrated proteid feeds, especially cotton-seed meal. This has been emphasized by the new competition that cotton-seed meal is meeting in European markets through the importation from Manchuria of cake made of soy-bean meal. Owing to the failing supply of cotton seed in certain sections affected by the boll weevil, owners of cotton-seed-oil mills have urged upon farmers the desirability of growing soy beans. It is probable that profitable crops of soy beans as grain can be grown in every portion of the cotton belt if the proper varieties are secured. There is strong reason to believe that the varieties secured from southern China will be fully adapted even to the Gulf coast region. Should the boll weevil render cotton culture uncertain in any part of the South, the soy bean is one of the few crops that can be grown extensively in its stead and one that can be utilized either as a money crop or as farm feed.

Velvet beans.—Through the assistance of the Office of Foreign Seed and Plant Introduction, 15 distinct species or varieties of Stizolobium, all closely allied to the Florida velvet bean, have been obtained from various sources, mostly in Asia. These are being fully tested at Biloxi, Miss., and also in cooperation with the Florida Agricultural Experiment Station, at Gainesville. The Lyon bean, mentioned in the previous report, is so promising that quantities of seed of it were distributed this season. Another variety from Japan is so early that seed of it can be matured much farther north than that of any other species. The final value of the different sorts will depend mainly on their yield of seed per acre, as otherwise they are very similar. Hybrids between several of the species are being made by Mr. George W. Oliver.

Forage crops in the Great Plains area.—In cooperation with the offices of Dry-Land Agriculture, Western Agricultural Extension, and Grain Investigations, tests are being conducted to determine the best drought-resistant forage crops on each dry-land experiment farm maintained by this Bureau. The preliminary work includes test rows and plats of all crops that have any likelihood of succeeding. The yields of hay from alfalfa and perennial grasses, both in broadcast plats and cultivated rows, are being compared to determine whether the latter method is practicable. Special attention is being devoted to Canada peas in the northern half of the Great Plains and to various annual legumes southward. The work is in immediate charge of Mr. H. N. Vinall.

Green-manure crops in California.—For the past four years investigations have been under way to determine the best legumes to use as winter green-manure crops in California. This work has been conducted at the Plant Introduction Garden, at Chico, and in cooperation with numerous orchardists, mainly in the citrus regions. The results of this work have been prepared for publication. The specially noteworthy conclusions reached are that the Black Bitter vetch (*Vicia ervilia*) is likely to replace common vetch very largely; that fenugreek, originally introduced by the Office of Foreign Seed and Plant Introduction, should be used to a much greater extent near the coast; and that the Tangier pea (*Lathyrus tingitanus*), black-purple vetch (*Vicia atropurpurea*), and horse bean (*Vicia faba*) are all excellent crops whose future use will depend largely on whether the price of seed per acre sown will not exceed too greatly that of common vetch.

Forage-crop testing in the sand hills of Nebraska.—The study of forage-crop conditions in the sand-hill districts of Nebraska was inaugurated in June, 1908. Many of the best farmers have eagerly cooperated in the testing of brome-grass, sweet clover, and the hardy strains of alfalfa in the drier portions, and red clover, alsike clover, timothy, and redtop in the wet valley sections. The results of these investigations and experiments emphasize the fact that this region must remain a stock-raising country, although the industry can undoubtedly be carried on much more intensively than it has in the past. The growing of legumes for forage will very materially benefit the sandy soils and will also prove advantageous to stock raising. Sweet clover has proved to be a valuable crop on very sandy soils and is especially recommended as a crop to be grown before alfalfa.

CONGRESSIONAL SEED DISTRIBUTION.

The Congressional distribution of seeds and plants during the past year included, as heretofore, varieties of vegetable, flower, cotton, tobacco, and lawn-grass seeds, as well as bulbs, grapevines, and strawberry plants. A limited number of hybrid citrus trees were also distributed.

Vegetable and flower seeds.—The contract for packeting, assembling, and mailing the vegetable and flower seed was awarded to the Brown Bag-Filling Machine Company, of Fitchburg, Mass., at $1.10 per 1,000 packets. Work was begun on November 9, 1908, and completed on April 13, 1909, involving the putting up and mailing of 27,424,905 packets of vegetable seed and 3,827,460 packets of flower seed. The number of packets distributed the past year was smaller than in former years, owing to the higher cost of seeds without a corresponding increase in the appropriation.

Tobacco, cotton, and grass seeds.—Of selected tobacco seed 13,088 packets were distributed to persons especially interested in securing the best types of standard varieties, as well as new and improved varieties. This seed was the result of the tobacco-breeding work of the Bureau. Nearly 10,000 packages of cotton seed were distributed, consisting of improved Upland and wilt-resistant varieties developed by the plant breeders of the Bureau. In the lawn-grass seed distribution 15,841 packages were sent out, Bermuda grass being sent to the Gulf States and the Southwest and a mixture of Kentucky bluegrass, redtop, and white clover to other localities.

Bulbs, plants, and citrus trees.—Assorted varieties of hyacinth, tulip, and narcissus bulbs were obtained from Holland and distributed for fall planting. The total number of packages sent out was 10,226, each package or box containing 20 bulbs. Twenty-six varieties of grapevines and 27 varieties of strawberry plants suitable for distribution were grown for the Department under contract, the past year's distribution involving 26,200 grapevines and 91,500 strawberry plants. The distribution of the new hardy oranges, or citranges, developed by the Bureau was continued in sections where climatic and soil conditions are suitable for growing these varieties. These trees are distributed only to persons who are in a position to give them proper care and who will agree to report results to the Department.

Miscellaneous seed distribution.—An assortment of seeds was sent to Prof. C. C. Georgeson, Director of the Alaska Experiment Station, who reported satisfactory results from seeds sent him for testing in previous years. Vegetable and flower seeds were also sent to various army posts and to persons in Hawaii and the Canal Zone, care being taken to send only such seeds as are likely to succeed in those climates.

Propagation of Dutch bulbs in America.—In accordance with plans outlined in the last report, a supply of assorted bulbs was secured from Holland and planted in the bulb garden which the Department has established near Bellingham, Wash. The bulbs have made good progress during the present season, and the work of propagation is well under way. A suitable building for storing the bulbs is nearing completion, a well has been dug, and other improvements have been made, the expenses of this work being borne by the Chamber of Commerce and the enterprising citizens of Bellingham. The results so far obtained are very encouraging, and it is believed that in about five years a sufficient quantity of bulbs can be grown at the garden to meet the requirements of the Congressional distribution and to demonstrate to commercial seed growers and others the feasibility of supplying the trade with American-grown bulbs, thus aiding in the establishment of a new and profitable industry in the Puget Sound region of Washington and at any other points where conditions are favorable. The value of the bulbs annually imported into this country from Holland is nearly a half million dollars. The bulb garden at Bellingham is in charge of Mr. H. E. Juenemann, as superintendent, whose work during the coming year will be under the supervision of Mr. P. H. Dorsett, of the Office of Foreign Seed and Plant Introduction.

Plans for the next seed distribution.—The quantity of seeds to be distributed the coming season will be much greater than last year, Congress having provided a substantial increase in the appropriation for this purpose. Great care will be exercised, as heretofore, in securing only the best seeds the market affords, and all purchases will be made subject to rigid tests for purity and germination. During the coming year special attention will be given to the subject of better methods for cleaning seed. It will be necessary to secure additional warehouse space during the winter months for the storage and handling of the increased quantities of vegetable and flower seeds for the Congressional Seed Distribution. Orders have been placed and contracts entered into for the bulk of the seed required, and any shortages on account of crop failures will be made up by purchases in the open market this fall.

WORK AT SPECIAL TESTING GARDENS.

The Bureau has continued the operation of several testing gardens at various points where both new and standard crops are under trial. The work at the plant-introduction gardens at Chico, Cal., and Ames, Iowa, has already been described in this report.

SOUTH TEXAS GARDEN.

The South Texas Garden, at Brownsville, under the immediate charge of Prof. E. C. Green, Pomologist, has made good progress in its development during the past fiscal year.

Plantings at the garden.—Practically all of the 50 acres which were prepared for irrigation last year have been planted to various crops for testing, and additional land for this purpose is being prepared. During the past year the garden has received, planted, and cared for 1,434 varieties of seeds, plants, trees, and shrubs. A large portion of the garden has been devoted to forage experiments with and without irrigation. Various mixtures of cowpeas and sorghums have been grown with remarkably good results. The soil and climate appear to be specially adapted to growing coarse forage crops, which produce large yields under irrigation. Other plantings at the garden during the past year include 12 varieties of bamboos, 58 varieties of bananas, 18 varieties of sugar cane, and a number of varieties of oranges, pomelos, and lemons, including about 800 hybrid orange seedlings.

Cooperative work with farmers.—The testing work in cooperation with farmers has progressed satisfactorily, 68 farmers in the Rio Grande Valley and on the Gulf coast having been furnished with seeds and plants of promising crops. In two instances, owing to specially favorable soil or other conditions, extensive cooperative work has been undertaken with growers. Through cooperation with the South Texas Gardeners, an organization whose home is at the South Texas Garden, direct communication is maintained with the best farmers of the valley, located at practically every post-office in southernmost Texas. Through these correspondents it is possible to keep in close touch with the agricultural development of the section and to extend the work of the garden wherever practicable.

SUBTROPICAL GARDEN.

The Subtropical Garden, at Miami, Fla., was continued during the past year under the supervision of Mr. P. J. Wester. As the work at this station has progressed it has become possible for the Bureau to direct its energies in Florida to the field work throughout the State, and in pursuance of this policy arrangements have been made to turn over the Miami garden to the local authorities, to be operated by them under a cooperative arrangement with the Florida Agricultural Experiment Station and with this Bureau. This plan was put in effect at the beginning of the current fiscal year.

REPORT OF THE FORESTER.

U. S. Department of Agriculture,
Forest Service,
Washington, D. C., December 1, 1909.

Sir: I have the honor to transmit herewith a report of the work of the Forest Service for the fiscal year ended June 30, 1909, together with an outline of the plans for the work of the Service for the current fiscal year.

Respectfully,
Gifford Pinchot,
Forester.

Hon. James Wilson,
Secretary of Agriculture.

CLASSIFICATION OF EXPENDITURES.

The following statement classifies the Forest Service expenditures of the year under the several fields of work as they will be dealt with in this report:

Forest Service expenditures, fiscal year 1909.

Administration and protection of National Forests	$2, 955, 425. 01
Permanent improvements, National Forests	599, 471. 02
Federal cooperation	31, 572. 27
General investigations (including state and private cooperation)	267, 039. 15
Diffusion of information [a]	82, 790. 02
Total expenditures for Forest work	3, 936, 297. 47

This amount was derived from the following sources:

Agricultural appropriation act, for salaries and general expenses	$3, 296, 200. 00	
Agricultural appropriation act, for improvement of the National Forests	600, 000. 00	
Total Forest Service appropriations		$3, 896, 200. 00
Agricultural appropriation act, for naval stores industry ($10,000, less $1,050.68 carried over to fiscal year 1910)		8, 949. 32
Agricultural appropriation act, for paper tests (allotted to the Forest Service)		3, 100. 00
Total available from agricultural appropriation act funds		3, 908, 249. 32

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[a] Includes cost of stencils for addressing machines, $17,975. (See p. 408.)

Federal cooperation (expenditures reimbursed by other bureaus)	$15,239.41	
Contributed by other cooperators	26,687.63	
		$41,927.04
Total available for Forest work		3,950,176.36
Less unexpended balances to be returned to the Treasury:		
From appropriation salaries and general expenses	$13,335.78	
From appropriation improvement of the National Forests	528.98	
From appropriation paper tests	14.13	
		13,878.89
Total expenditures for Forest work		3,936,297.47

Under the law, unexpended balances are available for two years to meet any outstanding liabilities, but will, for the most part, revert to the general fund of the Treasury.

The total disbursements from appropriations were 14 per cent greater than those of the previous year, and the disbursements on account of the National Forests, shown in the first two items, were a trifle less than 14 per cent greater, but the National Forest area was increased during the year by nearly 18 per cent.

The total expenditures for all purposes are shown below:

Total expenditures for Forest work, as above		$3,936,297.47
Refunds to depositors of excess deposits	$40,098.73	
Fencing Montana national bison range	219.60	
Payments to State of 25 per cent of receipts from National Forests for fiscal year 1908	444,379.00	
Payments from timber receipts, on behalf of Uintah Indians (33 Stat., 1070)	5,348.07	
Payments from cooperative funds on account of 1908 liabilities	2,356.04	
		492,401.44
Total disbursements		4,428,698.91

The amounts paid to States and Territories, to be expended for roads and schools, were as follows:

Arizona	$42,631.27	New Mexico	$25,464.75
Arkansas	313.68	Oklahoma	554.48
California	52,183.02	Oregon	32,318.82
Colorado	59,761.28	South Dakota	8,253.47
Idaho	71,423.46	Utah	32,681.49
Kansas	643.55	Washington	13,855.31
Montana	61,941.46	Wyoming	35,170.48
Nebraska	2,349.77		
Nevada	4,832.71	Total	444,379.00

THE NATIONAL FORESTS.

AREA.

The net result of the additions, eliminations, and new Forests created during the year by Presidential proclamations was to increase the total National Forest gross area by 26,528.439 acres.

An extensive rearrangement of National Forest boundaries during the year, for better administration, with a renaming of many Forests, makes it possible to show the gross area changes only by States, as follows:

National Forest gross areas, by States.

State or Territory.	Area June 30, 1908.	Additions and creations.	Eliminations.	Area June 30, 1909.
	Acres.	*Acres.*	*Acres.*	*Acres.*
Arizona	13,385,990	2,121,543	248,672	15,258,861
Arkansas	1,991,899	1,197,882		3,189,781
California	25,605,709	2,364,483	1,682	27,968,510
Colorado	15,746,932	[a] 5,282	53,775	15,698,439
Florida		674,891		674,891
Idaho	20,336,427		[b] 237,398	20,099,029
Kansas	302,387			302,387
Michigan		163,373		163,373
Minnesota	294,752	909,734		1,204,486
Montana	20,402,676		12,980	20,389,696
Nebraska	556,072			556,072
Nevada	2,591,052	2,518,363		5,109,415
New Mexico	[c] 8,474,547	2,511,875	14,711	10,971,711
North Dakota		13,940		13,940
Oklahoma	60,800			60,800
Oregon	16,331,892		110,524	16,221,368
South Dakota	1,263,720	30,720		1,294,440
Utah	7,414,232	22,095		7,436,327
Washington	12,065,500			12,065,500
Wyoming	8,998,723			8,998,723
Total in United States	[d] 155,823,310	12,534,181	679,742	167,677,749
Alaska	12,087,626	14,674,000		26,761,626
Porto Rico	65,950			65,950
Grand total	[d] 167,976,886	27,208,181	679,742	194,505,325

[a] Increase in Colorado of 5,282 acres due to corrected figures from subsequent surveys in Battlement National Forest.

[b] Decrease in Idaho of 237,398 acres due to corrected figures by General Land Office in Pend Oreille National Forest.

[c] Increase in New Mexico total of 1,280 acres over that given in last year's report due to correction made after report was printed.

[d] Increase in totals over those given last year due to correction of New Mexico area as noted.

The names of the individual Forests, and their gross and net areas, on June 30, 1909, are shown below. Net areas, as here given, are obtained by deducting not only lands actually alienated through the issuance of patent or final certificate, but also claims entered or pending, in so far as these are known to the Forest Service through notification from the General Land Office.

Names of individual Forests and their gross and net areas June 30, 1909.

Forest.	Gross area.	Net area.	Forest.	Gross area.	Net area.
Arizona:	*Acres.*	*Acres.*	California—Continued.	*Acres.*	*Acres.*
Apache	1,785,711	1,745,981	Inyo [a]	1,458,444	1,308,444
Chiricahua [a]	287,520	278,808	Klamath	2,094,467	1,769,825
Coconino	3,689,982	3,148,577	Lassen	1,373,043	1,047,559
Coronado	966,368	942,598	Modoc	1,471,817	1,283,797
Crook	788,624	736,606	Mono [a]	813,789	779,514
Dixie [a]	626,800	621,600	Monterey	514,477	452,553
Garces	644,395	609,629	Plumas	1,407,053	1,095,711
Kaibab	1,080,000	1,079,720	San Luis	355,990	298,320
Prescott	1,541,762	1,440,362	Santa Barbara	2,027,180	1,794,055
Sitgreaves	1,470,364	1,331,884	Sequoia	3,079,942	2,628,742
Tonto	2,110,354	2,011,527	Shasta	1,754,718	670,552
Zuni [a]	266,981	138,661	Sierra	1,935,680	1,790,030
Arkansas:			Siskiyou [a]	37,814	33,546
Arkansas	1,663,300	1,127,060	Stanislaus	1,117,625	691,865
Ozark	1,526,481	577,201	Tahoe [a]	1,931,042	1,014,664
California:			Trinity	1,834,833	1,441,411
Angeles	1,350,900	1,167,740	Colorado:		
California	1,114,904	835,314	Arapaho	796,815	752,828
Cleveland	2,236,178	1,408,793	Battlement	759,002	754,538
Crater [a]	58,614	45,417	Cochetopa	932,890	907,299

[a] Forests situated in two States. Alienated areas apportioned.

Names of individual Forests and their gross and net areas June 30, 1909—Continued.

Forest.	Gross area.	Net area.
Colorado—Continued.	*Acres.*	*Acres.*
Gunnison	945,350	902,244
Hayden [a]	84,000	80,127
Holy Cross	595,840	567,202
La Sal [a]	29,502	29,342
Las Animas [a]	196,140	101,330
Leadville	1,184,730	1,006,765
Medicine Bow	659,780	639,342
Montezuma	1,175,811	1,061,802
Pike	1,457,524	1,292,187
Rio Grande	1,262,158	1,152,242
Routt	1,049,686	951,523
San Isabel	560,848	515,872
San Juan	1,460,880	1,277,986
Sopris	655,360	618,941
Uncompahgre	921,243	834,808
White River	970,880	955,233
Florida:		
Choctawhatchee	467,606	147,086
Ocala	207,285	151,195
Idaho:		
Beaverhead [a]	304,140	303,283
Boise	1,147,360	1,104,560
Cache [a]	276,640	270,880
Caribou [a]	733,000	716,160
Challis	1,161,040	1,160,880
Clearwater	2,687,860	2,502,000
Coeur d'Alene	1,543,844	1,252,784
Idaho	1,293,280	1,259,560
Kaniksu [a]	544,220	461,047
Lemhi	955,408	954,728
Minidoka [a]	619,204	596,644
Nezperce	1,946,340	1,930,558
Payette	844,240	771,760
Pend Oreille	913,364	830,036
Pocatello [a]	288,148	274,268
Salmon	1,762,472	1,752,752
Sawtooth	1,211,920	1,204,800
Targhee [a]	1,101,720	1,059,360
Weiser	764,829	663,509
Kansas:		
Kansas	302,387	190,967
Michigan:		
Marquette	30,603	21,109
Michigan	132,770	66,296
Minnesota:		
Minnesota	294,752	294,752
Superior	909,734	582,149
Montana:		
Absaroka	980,440	852,030
Beartooth	685,293	681,631
Beaverhead	1,506,680	1,502,397
Bitterroot	1,180,900	1,077,550
Blackfeet	1,956,340	1,788,820
Cabinet	1,020,960	901,756
Custer	590,720	524,870
Deerlodge	1,080,220	1,045,780
Flathead	2,092,785	1,911,457
Gallatin	907,160	600,480
Helena	930,180	784,130
Jefferson	1,255,320	1,136,909
Kootenai	1,661,260	1,409,314
Lewis and Clark	844,136	842,417
Lolo	1,211,680	890,512
Madison	1,102,860	1,089,272
Missoula	1,237,509	861,940
Sioux [a]	145,253	135,963
Nebraska:		
Nebraska	556,072	522,532
Nevada:		
Humboldt	1,158,814	1,046,762
Inyo [a]	62,573	52,573
Moapa	390,580	381,980
Mono [a]	535,337	513,912
Nevada	1,222,312	1,202,832
Tahoe [a]	61,085	33,316
Toiyabe	1,678,714	1,674,714
New Mexico:	*Acres.*	*Acres.*
Alamo	1,513,817	1,229,917
Carson	1,390,680	1,349,817
Chiricahua [a]	178,977	173,169
Datil	2,869,888	2,501,868
Gila	1,782,562	1,646,242
Jemez	944,085	916,905
Las Animas [a]	480	....
Lincoln	677,790	566,910
Manzano	587,110	435,930
Pecos	622.322	566,912
Zuni [a]	404,000	210,590
Oklahoma:		
Wichita	60,800	54,360
Oregon:		
Cascade	1,767,370	1,634,753
Crater [a]	1,061,220	828,097
Deschutes	1,504,207	1,275,637
Fremont	1,260,320	1,167,029
Malheur	1,167,400	1,003,078
Oregon	1,787,280	1,542,651
Siskiyou [a]	1,264,579	1,115,187
Siuslaw	821,794	400,294
Umatilla	540,496	388,256
Umpqua	1,567,500	1,155,400
Wallowa	1,750,240	1,582,183
Wenaha [a]	494,942	455,168
Whitman	1,234,020	1,114,154
South Dakota:		
Black Hills	1,190,040	1,039,910
Sioux [a]	104,400	97,770
Utah:		
Ashley [a]	947,490	898,330
Cache [a]	257,200	212,440
Dixie [a]	475,865	456,745
Fillmore	578,459	515,113
Fishlake	537,233	434,641
La Sal [a]	444,628	429,086
Manti	786,080	677,855
Minidoka [a]	117,203	79,723
Nebo	343,920	329,861
Pocatello [a]	10,720	9,479
Powell	726,159	721,479
Sevier	710,920	664,520
Uinta	1,250,610	1,215,273
Wasatch	249,840	230,666
Washington:		
Chelan	2,492,500	2,428,540
Columbia	941,440	748,520
Colville	869,520	764,920
Kaniksu [a]	406,520	323,346
Olympic	1,594,560	1,416,016
Rainier	1,641,280	934,000
Snoqualmie	961,120	684,142
Washington	1,419,040	1,371,890
Wenaha [a]	318,400	294,538
Wenatchee	1,421,120	787,170
Wyoming:		
Ashley [a]	4,596	4,596
Bighorn	1,151,680	1,144,344
Bonneville	1,627,840	1,602,938
Caribou [a]	7,740	6,860
Cheyenne	617,932	537,168
Hayden [a]	370,911	333,211
Shoshone	1,689,680	1,664,474
Sundance	183,224	142,002
Targhee [a]	377,600	373,160
Teton	1,991,200	1,944,600
Wyoming	976,320	961,520
Alaska:		
Chugach	11,280,640	11,188,975
Tongass	15,480,986	15,467,061
Porto Rico:		
Luquillo	65,950	32,975
Total	194,505,325	172,230,233

[a] Forests situated in two States. Alienated areas apportioned.

In the month of May a field investigation was begun of the present National Forest boundaries, to learn how they may be changed so as to exclude any land not properly included within them or to take in any naturally adapted to National Forest purposes. The results of this examination, which will be substantially, if not wholly, completed by the close of the field season, are being mapped to show the character of the land for a considerable distance on each side of all exterior boundaries, and will furnish the means for a more careful correction of the present areas, through both eliminations and additions, than has hitherto been possible.

CLAIMS AND SETTLEMENT.

The National Forests are still subject to reduction through future acquisition of land by private owners. This takes place (1) by the perfecting of claims initiated before the Forests were set aside, under public-land laws not operative after the Forest proclamation, except for claims already located, (2) by the location and perfection of new claims under those public-land laws which apply equally to National Forest lands and the unreserved parts of the public domain, and (3) by the taking up of National Forest lands listed for settlement under the Forest homestead law of June 11, 1906.

The determination of all questions of title rests wholly with the Department of the Interior, though a Forest homestead entry can be made only on land listed by that Department at the request of the Secretary of Agriculture. A proper safeguarding of the interests of the people at large, for whose benefit the National Forests are set aside, calls for such a scrutiny of claims for which patent is sought under the general public-land laws as will prevent the unlawful segregation of land from national ownership by private persons. While it would be altogether wrong if the Government, which has given the right to its citizens to patent National Forest lands under certain conditions, were to force a needless contest upon those who seek to exercise this right and are plainly entitled to what they seek, it is equally true that every perfected claim alienates land now owned by and held for the people of the United States, and that the interests of the latter should be defended against fraudulent claimants. Therefore, and at the request of the General Land Office, the Forest Service makes a field examination of claims within National Forests upon notification from the Land Office that patent has been applied for, and reports any facts thus brought to light. The Land Office then decides whether the facts reported call for a hearing to determine the right of the applicant to obtain patent.

New claims are initiated on National Forests chiefly under the mining laws. Especial care was taken, and will be continued, not to interfere with legitimate mining interests. To this end the cooperation of the various mining interests of the country has been extensively asked for and received. Mining claims were, so far as practicable, examined by geologists detailed by the Geological Survey and by expert miners employed by the Forest Service, and in all cases in which hearings are ordered because of facts reported by the Forest Service a geologist or mining expert now presents the facts. It is important, both on behalf of the Forests and in justice to claimants, that only persons technically trained in mining matters should report on mining claims, and so long as the funds necessary for the employment of such men are available this work will be exclusively in their hands.

While examinations of mining claims on National Forests by competent men are recognized by legitimate mining interests as an entirely proper and necessary course if the Forests so important to the mining industry itself are to be maintained, speculative mining claims located in order to float valueless stock—the great incubus of the mining industry—are seriously interfered with by an examination which prevents their passing to title until they can show compliance with the law in the requirement for a valid discovery.

Field examinations of 5,610 unpatented claims led to reports to the General Land Office concerning 5,115, as follows:

Reports to the General Land Office on unpatented claims.

Character of report.	Homestead entry.	Desert-land entry.	Timber and stone entry.	Mineral entry.	Total.
Favorable	1,405	37	316	1,245	3,003
Unfavorable	957	29	451	675	2,112
Total	2,362	66	767	1,920	5,115

Claims to National Forest land disposed of by the Department of the Interior.

Character of action.	Homestead entry.	Desert-land entry.	Timber and stone entry.	Mineral entry.	Total.
Patent issued	633	11	514	425	1,583
Canceled through relinquishment	334	4	3	10	351
Canceled after hearing	529	10	57	56	652
Total	1,496	25	574	491	2,586

National Forest lands are listed for homestead entry under the law of June 11, 1906, when an examination has shown that they are chiefly valuable for agriculture and not needed for public purposes. Examinations are made on the request of applicants. The applications and listings for 1909 compared with those for 1908 are shown below. A considerable excess of applications over examinations results from erroneous locations or other defects in the applications themselves, necessitating a new application, to the withdrawal of applications, or to applications for land which has already been examined. The total area listed since the passage of the law was at the close of the year 443,661 acres.

Applications and listings for homestead entry.

Fiscal year.	Number of applications at close of year.	Awaiting final action at close of year.	Number of tracts listed at close of year.	Acreage listed at close of year.
1909	3,811	3,095	1,382	148,654
1908	5,271	[a] 2,800	1,077	238,945

[a] Number corrected since last year's report.

For the sake of the Forests themselves as well as in furtherance of the principle of the best use of all kinds of land, the settlement of such areas within National Forests as can with advantage to the public be given over to agriculture is encouraged. Settlers on or near a Forest help, under a proper administrative policy, both its protection and development. Decision as to whether or not it is to public advantage that particular tracts should be opened to settlement presents, however, a complex problem. In deciding whether the land is chiefly valuable for agriculture the future needs of the community for timber and the expectation value of immature timber on the land must be considered, as well as the value of the agricultural crops which the land will produce if cleared. The National Forests are primarily a provision for the future. In many parts of the East the desire for new land in earlier days led to much clearing of tracts which have since reverted to forest, and usually inferior forest, because the land was not in reality adapted to permanent agriculture. The mistake must not be repeated in the West, where the consequences would be far more serious, because in dry climates the forest is much more easily destroyed. Even in the case of land which will permanently grow good crops, but which is covered with timber certain to be in great demand later, or with young timber just nearing market size, clearing at the present time may mean a loss like that caused by drawing money from a savings bank a few days before interest falls due.

It must also be recognized that heavily timbered land may be sought for other reasons than its agricultural value. In Idaho and eastern Washington the Forest Service recently investigated the use to which 116 perfected homestead claims in one locality had been put. These homesteads were of substantially equal natural adaptation to agriculture save for the fact that part were heavily timbered, part nontimbered land. Of the homesteads on nontimbered land every one was occupied and over 30 per cent of their total area was under cultivation, while of those on timbered land one-half of 1 per cent was under cultivation and a large majority of the claims had been sold to lumber companies.

In many cases final decision as to whether particular areas will find their best permanent use as agricultural or as forest land must be left to the future, because it is impossible to predict now what the relative demand for the products of the field and of the forest will be under conditions wholly changed from the present. In regions where improved land can be had for far less than the cost of clearing National Forest land that is no better, or where an abundance of cheap cut-over land is on the market, it is not believed that the extensive homesteading of heavily timbered National Forest land would now be a wise economic policy or a benefit to the West. On the other hand, wherever it may appear that land, even though timbered, might be farmed with advantage to the community, it should be recommended for listing as subject to homestead entry, usually after the timber has been harvested.

During the year 890 administrative sites were selected and withdrawn from entry and settlement. They are chiefly tracts needed for rangers' headquarters. A small proportion of the withdrawals were for forest nurseries.

ENFORCEMENT OF LAW.

It has been possible since the establishment of district headquarters to give much more effective assistance to the Department of the Interior in its hearings upon claims within National Forests. This coöperation has extended to practically all claims within National Forests which were apparently invalid or fraudulent. Out of 402 cases disposed of by decisions of the registers and receivers of the various local land offices or without hearing, the contentions of the United States were sustained in 291. There are now pending 738 cases. Cases involving 2,000 acres of valuable timber land in the Siskiyou National Forest, Oregon, were among the most important heard.

During the year 54 prosecutions for violations of state game laws were initiated by Forest officers. Local Forest officers are expected to assist state authorities in the enforcement of the state game laws, when this can be done without prejudice to the regular work of the Service. In localities where state officers show little interest in game law enforcement, or even opposition to Forest officers who try to enforce the laws, it is out of the question for Forest officers to take the brunt of a burden which belongs primarily to the State. Many reports of violations of game laws made by Forest officers were ignored, or where offenders were taken before justices of the peace the most convincing evidence failed to secure conviction. Where a popular prejudice against the enforcement of the State's game laws is acquiesced in by the State's local officers, the Forest Service will not undertake to enforce these game laws, for it could not enforce them if it tried, and the effort merely hampers the work of the Government in administering the Forests.

There were in litigation in federal and state courts 64 cases of timber trespass, 32 of grazing trespass, 19 of special-use trespass, 23 of fire trespass, and 19 miscellaneous cases, which included injunctions and criminal actions for larceny, bribery, and embezzlement. Of these suits, 75 were settled out of court, 9 civil and 12 criminal were won, 1 civil and 6 criminal were lost, and 54 are pending. Of the 6 criminal suits lost, 2 were for fire trespass, 1 was for embezzlement, and 3 were for grazing trespass. The last were criminal actions for violation of the regulations of the Secretary of Agriculture, and were passed upon by the United States district court for the southern district of California in a single decision, which held that violation of departmental regulations is not punishable as a crime. This decision was appealed by the United States to the Supreme Court in order that a definite ruling might be had upon the constitutional question involved. This question has been passed on by the lower courts a number of times, in a majority of cases in favor of the validity of the law which makes violation of the regulations a crime against the United States.

As against the 32 cases of grazing trespass in litigation, 306 cases were amicably settled. Of the 32 litigated cases, 7 were decided favorably to the Government, 15 cases were settled out of court favorably to the Government's contention, and 7 cases are still pending. The 3 remaining cases were those already referred to as having been appealed.

In the case of Lewis *v.* Garlock (168 Fed., 153) the circuit court for South Dakota decided that dead, mature, and insect-infested timber upon an unpatented mining claim within a National Forest may be sold by the Secretary of Agriculture, and that the rights of the claimants to the timber on such claims are subject to the Government's paramount ownership of the land on which the claims are situated.

COST AND USE.

The following tables show the cost of administration and protection, expenditures for permanent improvements, and receipts from the several sources, both in totals and per acre, during the past year, as compared with those for the fiscal year 1908:

Expenditures for administration and protection and permanent improvements during fiscal year 1909, compared with 1908.

Fiscal year.	Administration and protection.		Permanent improvements.	
	Total.	Per acre.	Total.	Per acre.
1909	$2,948,153.08	$0.01510	$599,471.02	$0.00309
1908	2,526,098.02	.01503	592,169.19	.00353

The per acre expenditures are here computed on the basis of the gross area of all National Forests under administration at the close of the year. If the net area were used instead of the gross the expenditures for all purposes would still be less than 2 cents per acre. Since interior holdings usually do not lower the cost of administration and protection, the gross area figures more nearly represent the facts. All costs incident to National Forest administration are charged in, including a fair proportion of the expense of the Washington offices of the Forest Service.

Comparison of receipts from the several sources for the fiscal years 1909 and 1908.

Fiscal year.	Grazing.		Timber.		Special uses.		All sources.	
	Total.	Per acre.	Total.	Per acre.	Total.	Per acre.	Total.	Per acre.
1909	$1,032,185.70	$0.00532	$736,102.08	$0.00379	$38,982.88	$0.00020	$1,807,270.66	$0.00931
1908	962,829.40	.00573	849,027.24	.00505	30,425.23	.00018	1,842,281.87	.01096

The receipts given above are without deductions for refunds of excess deposits. Such deposits are not, strictly speaking, National Forest receipts, though, under the law, they are covered into the Treasury as such. For example, timber is paid for by purchasers in advance of, and sometimes in excess of, the actual cutting. Refunds may or may not be made in the same fiscal year in which the payments were made, so that deduction of the refunds made during the year gives only approximately the true receipts. The refunds of timber receipts in 1909 amounted to $30,738.24, and of all receipts in 1909 to $40,098.73, as reported on page 372. Deduction of refunds would leave the total of receipts for 1909 $1,767,171.93 and for 1908 $1,793,602.86.

The grazing receipts for 1909 were paid by the holders of 22,163 permits to graze 1,585,905 cattle, horses, and hogs, and of 5,074 permits to graze 7,819,594 sheep and goats. The receipts from timber sales were paid by approximately 5,000 purchasers, who cut the equivalent of 352,434,000 board feet of timber. The receipts from special uses were paid by the holders of 1,112 permits, including 52 for the use of land in connection with water-power development. In other words, these receipts represent profitable use of the forests by some 33,000 individuals or concerns.

In issuing permits for reservoirs, conduits, power houses, and transmission lines for commercial power development, the Forest Service has steadfastly insisted on conditions designed to prevent speculative or perpetual holdings and to secure the full development of available power and the payment of reasonable charges for the use of land.

To the use for which payment was made must be added the heavy free use of the Forests by the public. For free use of timber see page 387.

As last year, the exact amount of free grazing on the Forests can not be stated, since no permit and therefore no record is involved. Not over 10 head of milch cows, work animals, or horses in use may be grazed free by settlers living within or near the Forests and by prospectors, travelers, and campers. In Arizona and New Mexico 30 milch goats may be grazed free. Stockmen and purchasers of timber on the Forests are also allowed free grazing for all horses in use. In the aggregate free grazing adds materially to the use of the Forests by stock, forming perhaps one-tenth of the total.

Of free special-use permits, 2,913 were issued during the year, as against 1,768 the year before. At the close of the year 5,540 were in effect, as against 2,731 in effect during the previous year.

EXECUTIVE FORCE.

The following shows the classification of the Forest force:

Supervisors	113
Deputy supervisors	79
Forest rangers	1,148
Forest guards	400
Forest assistants	81
Forest planting assistants	8
Lumbermen	15
Scalers	2
Experts and agents	14
Forest student	1
Forest examiners	4
Expert miners	13
Civil engineers	3
Superintendents of telephone construction	2
Telephone lineman	1
Inspectors of grazing	2
Game warden	1
Hunters and trappers	5
Forest clerks	120
Total	2,012

All of the National Forests except the Choctawhatchee and Ocala, in Florida; the Marquette and Michigan, in Michigan; and the Luquillo, in Porto Rico, were under administration at the close of the year—a total of 193,600,061 acres. Though the number of rangers and guards was 86 more than last year, the average area to each such officer was 125,065 acres, as against 116,665 acres last year. At the same time the demands upon these men were greater than ever before. Proper protection of the Forests as well as provision for the needs of users calls urgently for a larger field force.

No less important than provision for more men to protect the Forests and handle the business is provision for higher pay to those who have proved their right to promotion. Not long ago rangers and guards needed to be little more than manual laborers. Now the rangers are more and more intrusted with the conduct of local business, often supervising the work of others and called on to exercise initiative, judgment, and tact.

Efficient administration of the Forests depends first of all on building up and maintaining a body of capable and well-trained Forest officers. Since the Forest Service took charge of the National Forests the personnel has gradually but almost completely changed. Of 50 supervisors in office at the time of transfer, only 13 are still in the Service. Some have left to take more attractive employment open to them, many others for the good of the Service; and though a number have proved their efficiency and remain among the most valued of the present Forest force, practically none entered on their work with technical preparation for it. There are now 28 National Forest supervisors and 20 deputy supervisors who have had technical training in forestry, and the proportion of such men is rapidly increasing. But while eventually thorough technical training will be indispensable for all supervisors, a good knowledge of western conditions, combined with integrity, intelligence, and practical sense, is a requirement of first importance. To the men of this character, who are now faithfully and efficiently handling their Forests, the success of the Service as an administrative organization is in very large measure due. They deserve the gratitude, as they have won the local esteem, of the public, for without them a great work could not have been done.

The natural recruiting ground for supervisors is found in the lower ranks of Forest officers. For this reason, as well as because of the increasing responsibilities which fall on rangers and the growing need of special qualifications for their work—such, for example, as a knowledge of elementary surveying and silviculture—the highest efficiency of the present National Forest organization calls for better trained rangers. Both through direct instruction and through cooperation with state colleges and universities to provide for the opening of ranger courses this need was met. Sixteen meetings of supervisors and rangers were held during the year to discuss the best methods of handling National Forest business, 9 of which were attended by representatives of the district offices. The short courses in forestry previously given by the Utah Agricultural College and the Colorado State Agricultural College in cooperation with the Forest Service were repeated, and a similar course was started at the University of Washington. These courses were attended by many rangers and by men preparing to enter the Service. Plans were made for opening the same kind of courses elsewhere.

BUSINESS ORGANIZATION.

The reorganization of the Forest Service forecast in the Report of the Forester for 1908 was successfully accomplished December 1, and the plan of organization has remained as shown on page 37 of that report. The boundaries of the districts were modified later to include in District 1, the Minnesota and Superior Forests, previously in District 2, and the new Marquette and Michigan Forests; in District 3, the new Choctawhatchee and Ocala Forests; and in District 2, the Bighorn and Shoshone Forests, transferred from District 1, and the Bonneville Forest, transferred from District 4.

The beneficial effect of the district organization has been extraordinary. Those in charge of the various lines of work of the Service are brought into much closer contact with the National Forest officers and their work, business is greatly expedited and a higher standard of business efficiency set, a decided stimulus has been given to technical work, and differences with Forest users are more quickly and satisfactorily adjusted. Along with better oversight of the work of the supervisors the new system has brought not a greater centralization of responsibility for the handling of local business, but, on the contrary, an increase in the responsibility laid on local officers. In short, the supervisor is in closer touch with his superior officers, and yet freer to do high-grade work in planning and bringing to pass the best use of the Forest of which he has charge than has ever been the case before. This is believed to be the ideal administrative method for the Service, since it avoids the evils of bureaucratic control on the one hand and irresponsible decentralized administration on the other. A marked gain in the approval by western public sentiment of National Forest work has evidenced the success of the new plan.

Under the method previously used for bringing about a closer touch between the field and office parts of the organization 26 field men detailed from the National Forests took part in the work of the Washington office between July 1 and December 1. After the new organization went into effect the same end was attained by the detail of 53 men from the Forests, for an average period of five weeks, to assist in the work of the district offices.

The depot at Ogden, Utah, for the distribution of materials and supplies needed on the National Forests and at field stations in the West went into operation at the beginning of the fiscal year. It was the forerunner in the westward movement from Washington of work formerly handled there, and through the promptness with which it met the demands for office equipment and supplies required for the district offices was an important element in the immediate success of the new organization. Requisitions from the National Forests were filled with much greater expedition than was ever before possible. The delivery directly to the depot of supplies purchased on contract aided greatly in the successful prosecution of this work.

A system of charging the value of all materials against the executive and administrative offices to which they were furnished was installed, and by this means a comparison was made possible between the amounts used by the different units in the Service.

OBJECTS AND RESULTS OF ADMINISTRATION.

As stated last year, the purposes of National Forest administration are (1) protection against fire and trespass; (2) the harvesting of timber when mature, under such limitations as the need of a reserve for future supplies of timber and the need of watershed protection impose; (3) the maintenance and betterment of a growing crop of timber; (4) the protection of the water supply; (5) utilization of the forage crop; (6) betterment of range conditions; and (7) equipment of the property with adequate means of communication and transportation and with necessary field quarters, in the interest of more effective protection and increased use.

The work of the year along these lines will be outlined under the three heads of forest management, range management, and permanent improvements.

FOREST MANAGEMENT.

Stand, distribution, and cut of National Forest timber.—The total stand of National Forest timber was reported last year as 390,000,000,000 feet. Additions to the total area of the Forests made during the year increased this amount by some 10,000,000,000 feet. This does not include the timber in the two National Forests in Alaska, the amount of which is not known.

The loss of National Forest timber by fire can be given only for the calendar year 1908, since records of fires are not kept by fiscal years. That year was one of prolonged drought during the summer and fall, and of disastrous forest fires throughout the country. The National Forests suffered relatively little. In these, fires burned over 414,638 acres, of which 111,496 acres were timbered, as against 212,850 acres, of which 29,365 acres was merchantable forest, the previous year. About 232,191,000 board feet of timber, or 0.06 per cent of the stand, was destroyed. The value of this timber was estimated at $415,188, as against $31,590 for the previous year. A total of 2,728 fires was reported, of which 2,089 were small fires confined as a rule to an area of 5 acres or less. The cost of fire fighting, exclusive of the salaries of Forest officers, was $73,283.33. This sum, added to the proportion of the total salaries of rangers and guards properly chargeable to patrol and fire fighting, was less than one-twentieth of 1 per cent of the value of the timber protected, estimated at an average stumpage value of $2 per thousand.

Through cooperation with States and associations of timber-land owners forested areas adjoining the National Forests, from which fire would find entrance into the Forests themselves, were protected. The States of Oregon, Washington, and California commissioned the Forest rangers in those States as fire wardens, and effective aid was given by the Oregon Conservation Association and the Washington Forest Fire Association. Agreements were entered into for cooperative fire patrol and methods of fighting fires with four timber protective associations controlling lands contiguous to the Clearwater, Coeur d'Alene, Pend Oreille, and Kaniksu Forests in Idaho, and a number of rangers on each Forest in that State were made fire wardens. Steps in the direction of similar action were taken in other States, with every prospect of good results. Negotiations were started for cooperative agreements with railway lines for the prevention of fires on their rights of way through the National Forests, and it is anticipated that thoroughly efficient cooperation will be effected early in the ensuing year. Without formal agreements, many of the roads issued more rigid instructions to their employees for the prevention of fires, and their agents were required to notify Forest officers regarding fires when detected by them. In some instances trains were furnished without cost for the transportation of fire fighters. A keen realization by railway officials of the effect of fire in the loss of future business, the danger to their roadbeds from floods and snowslides resulting from the destruction of forest cover, and the loss in scenic attraction was evidenced.

Users of the National Forests whose interests were threatened by fire cooperated with the Forest officers in meeting the common danger. From the most complete reports obtainable it was calculated that the money value of this cooperation during the calendar year 1908 amounted to $18,114.83. The Forest Service in turn gave aid in the suppression of fires outside of the National Forest boundaries which threatened timber within them to the amount, in the cost of hired labor and fire-fighting supplies, of $9,057.33.

Estimates showed about 95 billion feet of the National Forest timber to be in California, and 90 billion each in Oregon and Washington. These three Pacific Coast States have therefore about 70 per cent of all the timber. Montana and Idaho have about 35 billion each, or together about 18 per cent. Colorado and New Mexico have about 12 billion feet, or 3 per cent, each. The remaining 6 per cent is scattered in the National Forests of other States.

Of the timber cut under sales during the year, 25 per cent, and of that cut under free use, 27 per cent, came from these other States. Colorado furnished 12½ per cent of the total cut under sales and 13 per cent of that cut under free use, while New Mexico furnished 3½ and 9 per cent. Idaho furnished 10 per cent of the cut under sales and 18 per cent of that under free use, while Montana furnished 24 and 16 per cent. The three Pacific Coast States furnished together 20 per cent of the cut under sales and 17 per cent of that under free use. In other words, the National Forests are being most heavily cut, in proportion to the stand, not where the largest supplies are, but where the need of the community for timber is greatest.

The figures of the cut in board feet, however, place the States in a somewhat different order from that which might be looked for from these percentages, as is shown by the following table:

Timber cut from National Forests.

State or Territory.	Cut under sale.	Cut under free use.	Total cut.
	Feet.	*Feet.*	*Feet.*
Montana	85,766,000	16,767,000	102,533,000
Colorado	44,111,000	13,525,000	57,636,000
Idaho	34,532,000	18,518,000	53,050,000
California	39,445,000	6,885,000	46,330,000
South Dakota	29,019,000	4,319,000	33,338,000
Wyoming	24,437,000	6,550,000	30,987,000
Washington	22,037,000	4,345,000	26,382,000
Arizona	21,029,000	4,660,000	25,689,000
New Mexico	12,834,000	9,887,000	22,721,000
Utah	10,465,000	10.177.000	20,642,000
Oregon	10,391,000	6.377.000	16,768,000
Alaska	15,550,000	42,000	15,592,000
Nevada	2,710,000	1.612,000	4,322,000
Arkansas	49,000	879,000	928,000
Minnesota	....	599,000	599,000
Oklahoma	59,000	60,000	119.000
Nebraska	....	3.000	3,000
Total	352,434,000	105,205,000	457,639,000

TIMBER SALES.—Naturally the extent of the market for National Forest timber depends on the population and industries of each region, the transportation facilities, the amount of timber in private holdings, and general business activity. Timber sales are heavy in Montana because the local demands of a rapidly developing region and of the mines is great, because railroads are available to carry lumber to the general market in the nontimbered regions farther east, and because there is relatively little timber outside of the Forests. They are heavy in Colorado primarily to supply the mines of the State, and in California because of the diversified demands of that great Commonwealth. But in general the National Forests may be said at present to front the East, while the heaviest supplies lie far to the West and in regions in which vast holdings of private timber are awaiting a market. Timber which brings relatively little now, because it is relatively little needed, but for which there will be a strong demand shortly, neither can nor should be sold too freely.

The opening of the Panama Canal will of itself almost revolutionize the situation. Cuttings which can not now be made in the best way for the welfare of the Forest, because only the relatively high grades of timber can be sold, will then be practicable under much more favorable conditions. Sales of National Forest timber are certain to increase steadily and even rapidly because of the needs of the growing western country, but they should not increase too rapidly now.

The ratio of the cut under sales to the stand in each State shows that in the regions where the demand is greatest and the cutting heaviest the Forests are not overcut. Except in South Dakota, where a disastrous insect attack has forced large sales as a protective measure and to utilize dead or dying timber, and in Nevada, where the scarcity of local supplies has made it absolutely necessary to draw heavily upon them with the expectation of bringing in timber eventually from a greater distance, the cut under sales has in no State reached 1 per cent of the present stand. In Wyoming it was 0.5 per cent, in Colorado less than 0.4 per cent, in Arizona, Oklahoma, and Montana 0.3 per cent, and in Utah less than 0.2 per cent, while in California less than 0.05 per cent of the stand was cut under sales, in Washington less than 0.03, in Oregon about 0.01, and in New Mexico 0.001. The lowest place was held by Arkansas, with 0.0003 per cent.

The sales of timber and the cut under sales (partly made in previous years) were as follows:

Timber sold and timber cut under sales from the National Forests.

State or Territory.	Timber sold.		Timber cut under sales.	
	Amount, board feet.	Value.	Amount, board feet.	Value.
Arizona	13,472,000	$18,785.11	21,029,000	$40,972.29
Arkansas	93,000	164.09	49,000	70.26
California	24,631,000	48,543.44	39,445,000	67,661.15
Colorado	44,140,000	75,568.91	44,111,000	77,904.30
Idaho	42,242,000	98,035.37	34,532,000	77,045.63
Montana	30,706,000	65,620.75	85,766,000	207,229.75
Nevada	4,408,000	14,336.07	2,710,000	8,718.36
New Mexico	10,149,000	18,326.71	12,834,000	21,012.76
Oklahoma	58,000	131.70	59,000	163.20
Oregon	30,236,000	75,192.87	10,391,000	16,333.85
South Dakota	12,864,000	19,280.51	29,019,000	34,848.25
Utah	7,057,000	13,610.23	10,465,000	18,563.72
Washington	51,702,000	92,940.60	22,037,000	38,492.68
Wyoming	8,298,000	23,198.59	24,437,000	59,298.76
Alaska	6,610,000	5,168.07	15,550,000	9,469.39
Total—Fiscal year 1909	286,666,000	568,903.02	352,434,000	677,784.35
Fiscal year 1908	386,384,000	736,024.97	392,792,000	794,251.61

These figures show an average stumpage price for 1909 of $1.98 per thousand, as against $1.90 obtained in 1908.

The total value of the timber cut under sales as given above is less than the receipts from timber as given on page 379, both because the latter includes the receipts from timber and fire trespass and because payment for timber is required in advance of cutting.

The fiscal year 1908–9 was one of depression in the lumber business throughout the country. For the calendar year 1908 the lumber cut for the whole country was 17.5 per cent less than for 1907. For the fiscal year 1907–8 the timber cut from National Forests under sales was over 100 per cent greater than for the year before, but for the year 1908–9 it was 10.3 per cent less than for 1907–8. This decline was due very largely to the falling off in the demand for lumber in the large distributing centers. From the beginning the Forest Service has handled its sales to meet local demands first of all, and has sold timber for the general market only where this would not jeopardize the future local supply. As a result sales of timber for local consumption continued and even increased slightly during a year in which few sales were made for the general market, and in which several purchasers of timber in large quantities were compelled, like many firms operating outside the National Forests, to suspend operations.

Number and size of sales of timber from National Forests.

State or Territory.	Number of timber sales—					Total number of sales.
	Under $100.	$100 to $500.	$500 to $1,000.	$1,000 to $5,000.	$5,000 to $100,000.	
Arizona	800	10	1	1	....	812
Arkansas	13	....	....	....	....	13
California	524	29	7	4	....	564
Colorado	612	36	10	11	3	672
Idaho	495	55	10	13	4	577
Minnesota	....	....	....	....	....	....
Montana	922	23	6	7	1	959
Nebraska	....	....	....	....	....	....
Nevada	165	6	4	1	....	176
New Mexico	275	10	1	3	1	290
Oklahoma	65	....	....	....	....	65
Oregon	97	8	2	4	3	114
Douth Dakota	224	12	4	5	....	245
Utah	212	14	4	2	....	232
Washington	36	3	....	3	3	45
Wyoming	83	15	2	2	1	103
Alaska	102	8	2	1	....	113
Total—Fiscal year 1909	4,625	229	53	57	16	4,980
Fiscal year 1908	4,585	326	63	71	17	5,062

In the Pacific Coast States, which contain so large a part of the total stand of National Forest timber, sales are made only when a fair price is offered and only under restrictions which safeguard the future welfare of the forest. Both these conditions tend to restrict sales in a region where timber is at present so abundant and so cheap. The depression in the lumber business in Washington and Oregon was shown by a cut 22.8 per cent less in Washington and 10.2 per cent less in Oregon for the calendar year 1908 than for 1907. Nevertheless, the cut of National Forest timber under sales increased last year

61.5 per cent for the State of Washington, and practically trebled in Oregon. The cut in this region, however, is still and probably for some years must be very low in proportion to the amount of timber on the Forests.

In cutting National Forest timber the future productivity of the land was better safeguarded than ever before. The establishment of the district offices in the West made possible closer supervision and better instruction of local Forest officers in marking the trees to be cut. A steady advance in the practice of forestry takes place as the results of the work of past years become apparent and as more technical studies are made. This is especially true in the western yellow pine forests, where the difficulties of securing reproduction are usually great.

Efforts to sell bodies of dead timber before they become total losses were continued with success. So far as possible, sales of green timber were made where the timber was overripe and rapidly deteriorating. In Idaho and Washington especially, there is much timber which is decreasing in stand and in value. In these bodies of timber, sales are especially desirable, and they are being made when logging and market conditions will permit.

Other sales were made to dispose of insect-infested timber. Insect attacks which get beyond control are sometimes far more serious than a great conflagration, and, like fires, they require action to check them while they are still small. Work against insects was carried on in the Black Hills, San Isabel, and Las Animas National Forests. Where timber needed to be cut to protect the Forests could not be sold it was given away. In some cases it was even necessary to cut and peel trees at the expense of the Government. Through cooperation with the Bureau of Entomology it has been learned that the complete destruction of the trees is usually not necessary, but that cutting and peeling and in some cases burning the bark at certain seasons of the year is sufficient.

TIMBER TRESPASS.—A decline in timber trespass is evidenced by the fact that the payments in settlement of such trespasses during the year amounted to $43,109.39, including $3,778.04 received for fire trespass, as against $55,405.76 for the previous year. There is very little timber trespass on Forests which have been under administration for any length of time. Most of the cases are either of trespass committed before the Forests were created or of unintentional trespass. With the opportunity to buy timber from the Government on reasonable terms, the main cause of depredations is removed.

FREE USE OF TIMBER.—The following statement shows a free use of National Forest timber somewhat greater in the number of permits and practically identical in the value of the material, but less in the amount taken, than in the fiscal year 1908. The falling off in amount was due to a year of inactivity in settlement and in mining. The development of prospects by miners in ordinary years takes large amounts of low-priced timber. On the other hand, the demand of farmers and ranchers for the more valuable saw timber and fence-post material was greater than ever before.

Free use of timber on National Forests.

Fiscal year.	Number of permittees.	Cut.	Value.
		Board feet.	
1909	33,431	105,205,359	$169,081.12
1908 [a]	30,377	131,976,840	169,320.00

[a] Corrected figures, varying slightly from those given in last year's report.

Through free use much dead timber which would otherwise be a total waste is utilized. Green timber formed only 21.4 per cent of the total cut, as against 24.1 per cent in 1908.

Many persons entitled under the regulations to free use found it more profitable to buy their timber from mill men or woodcutters than to cut it themselves. This caused a falling off in free use on some Forests. On the other hand, there was a marked increase in free use along new lines of railroads, especially in Montana and South Dakota.

The setting aside of areas of timber for the free-use supply of communities was vigorously pushed forward and was found to work admirably, both from the standpoints of convenience to permittees and of economical administration. In consequence, settlers desiring timber for the development of unimproved land and prospectors needing timber to develop their claims obtained their timber more readily than before, and the cutting was done where the advantage to the future forest would be greatest.

Reforesting.—During the year special stress was laid on the work of reforesting. There is much denuded National Forest land, the result of repeated fires and of indiscriminate cutting and grazing in past years, which, unless forested artificially, will not produce timber. To restock artificially the entire unwooded area would involve a prohibitive cost. But the entire area need not be planted. The denuded area remains bare, even when protected from fire, because of the lack of seed trees. Small areas restocked here and there will form islands from which the forest will extend itself naturally until these islands join.

Denuded city or irrigation watersheds, however, are of so great economic and sanitary importance that artificial reforestation is not only economically justifiable, but imperative. The planting and sowing of the year was almost wholly on such watersheds.

Planting or sowing is also called for to try new species. It is believed, for example, that the white pine of the East and the Austrian pine and Douglas fir of the West can be successfully grown in the Black Hills Forest of South Dakota, and that the Jeffrey pine can be advantageously started in some of our southwestern Forests.

The field planting, sowing, and seed collecting of the year are shown below:

Area planted, area sown, and quantity of seed collected on National Forests.

District.	Area planted.	Area sown.	Seed collected.	District.	Area planted.	Area sown.	Seed collected.
	Acres.	*Acres.*	*Pounds.*		*Acres.*	*Acres.*	*Pounds.*
1	5.25	89.75	2,510	5	237	25.42	279
2	265.76	741.43	5,806	6	1.90	65.45	706
3	91.04	38.25	1,941				
4	10	165.50	2,500		610.95	1,125.80	13,742

There are in all 24 nurseries on the National Forests, of which all but 9 are small or merely experimental nurseries. The condition of the nurseries at the close of the calendar year 1908 is shown below:

Nurseries on National Forests, close of calendar year 1908.

Nursery.	Forest.	Annual productive capacity.	Ready for planting.
		Trees.	*Trees.*
Trapper Creek	Bitterroot	12,800	
St. Regis	Lolo	20,000	
Packer Creek	do	10,000	
Elkhorn	Helena	105,600	
Trail Creek	Madison	48,000	
Garden City	Kansas	300,000	23,000
Halsey	Nebraska	500,000	257,500
Monument	Pike	150,000	500
Brown Creek	Leadville	3,000	
Cottonwood	do	13,000	
Hardscrabble	San Isabel	50,000	
Norrie	Holy Cross	30,000	
Gallinas	Pecos	240,000	22,400
Fort Bayard	Gila	500,000	149,300
Fort Stanton	Lincoln		10.000
Frye Canyon	Crook		4,000
Wasatch	Wasatch	4,000,000	40,500
Pocatello	Pocatello	1,000,000	
Upper J	Manti	80,000	
Long Gulch	Boise	15,000	
Lytle Creek	Angeles	500,000	65,000
Las Preitoss	Santa Barbara	200,000	124,000
Ranger Nurseries	Cleveland	25,000	15,000
Cerro Alto	San Luis	1,000,000	10,000
Total		8,802,400	721,200

At these nurseries steady progress is being made in working out the best methods of growing the needed planting stock in large quantities. Much experiment is required to meet the problems presented by climatic conditions, fungus and insect enemies, and other difficulties incident to raising economically nursery stock suitable for National Forest planting. The stock must be grown under natural conditions similar to those which they must face when finally set out, if they are to live. Year by year the nursery work reaches a better basis.

The entire stock on hand at the nurseries at the close of the calendar year 1908 consisted of 5,570,925 seedlings and 1,497,400 transplants, of which 3,214,500 were Douglas fir, 1,545,200 western yellow pine, 877,000 jack pine, 440,575 Engelmann spruce, 282,700 Scotch pine, and the remainder of some twenty other species.

INVESTIGATIONS.—As a preliminary to the making of working plans for the management of the National Forests, reconnaissance studies are conducted. These furnish data as to the quantity and character of standing timber, the rate of growth of the different species, the most desirable locations for sales, and the logging methods which should be used. Such information helps both the Forest Service to sell timber to the best advantage and the would-be purchaser to buy. These studies were carried on in the Pike, Coconino, Crook, Lincoln, Manzana, Pecos, Prescott, and other Forests.

To further scientific investigations of National Forest problems, an experiment station was established near Flagstaff, Ariz., on the Coconino Forest. Results of both scientific and practical value have already been secured. They point the way to the proper method of cutting yellow pine in the Southwest to secure natural reproduction. This is the most urgent problem of forest management in this great region.

Other problems were attacked by means of permanent sample plots laid out on many Forests. These will secure accurate data through experiment concerning such matters as the re-covering of denuded areas, thinnings and reproduction cuttings, sowing and planting, the introduction of new species, and the best effects of different methods of cutting. A study of natural parks is also under way.

A study just completed of the life history of the lodgepole pine burns of Colorado bears directly upon the management of the extensive lodgepole pine forests, places this pine among the best known forest trees in this country, and has disclosed new methods of investigation.

The encroachment of lodgepole pine on western yellow pine on the east slope of the Cascade Mountains in Oregon was another subject of investigation. It was found that fires and injudicious cutting of yellow pine have enabled the lodgepole pine to crowd out the more valuable yellow pine from a great area, with a very serious resulting decrease in the value of the Forest.

Insect infestations on the National Forests were studied in cooperation with the Bureau of Entomology, and diseases of forest trees in cooperation with the Bureau of Plant Industry.

Forest Atlas.—The work of compiling the Forest Atlas was continued in Washington and begun in the district offices. The information gathered from supervisors and the business transacted in each district office, together with the status of lands within National Forests received from local land offices, are now prepared for record and posted in a District Atlas. Duplicate atlas sheets showing the corrections and additions posted are forwarded to Washington. There were assembled into atlas folios 126,877 sheets. The atlas now numbers 160 volumes, as against 70 a year ago. Forty-five folios were prepared for district and supervisors' offices.

RANGE MANAGEMENT.

The relations between the Forest Service and the stockmen are yearly becoming more harmonious. This is due principally to recognition of the fact that a proper regulation of grazing on the Forests has benefited the stockmen, but largely also to the fact that Forest officers have become more accustomed to handling grazing matters. In nearly all the Western States permission to graze sheep on a National Forest is regarded as a valuable privilege, and established stock ranches within and adjacent to the Forests have an enhanced worth for this reason.

The total number of National Forests under grazing administration June 30, 1909, was 139, with a total area of 163,744,706 acres.

Range conditions.—During the fall of 1908 National Forest range conditions were almost everywhere extremely satisfactory. Live stock of every kind left the range in excellent flesh. But the winter of 1908–9 in the Southwest was one of the most severe known for many years. Snow covered the winter grazing grounds to an unusual depth and became heavily crusted, forcing the stockmen to feed hay until they faced a hay famine. The spring was fully a month later than usual and very cold. Damaging storms over a large portion of the southern Rocky Mountain region from central Wyoming south caused considerable losses of newly sheared sheep, and later cold weather and lack of green feed caused heavy mortality among the young lambs. Throughout the Southwest the average increase of both lambs and calves was very low.

Every possible step was taken by the Forest Service to relieve the stockmen. Stock were allowed to enter some Forests earlier than usual, but many of the lambing grounds were covered with snow from 2 to 4 feet deep. Some of the Forests were entered fully a month late. Where this happened fees were returned or the fall grazing period was extended. On the Pecos Forest, which had been closed against sheep to protect the watersheds around the head of Pecos River, permission was given to graze 25,000 head of sheep until the outside ranges would support them.

When the cold weather finally ceased, however, the immense snowfall on the ranges caused a remarkably heavy growth of grass, with plentiful water, and the stock improved rapidly. Except in parts of New Mexico, the condition of the stock on all the National Forests was by midsummer fully up to the average of previous years. The prospects for fat stock of every kind on the National Forests at the close of the season are excellent.

Upon few of the National Forests will any reduction in the number of stock now grazed under permit be necessary. In one or two of the Forests in Oregon and Washington it has been hitherto impossible to reduce the number to the point called for by the welfare of the range without serious injury to the industry. It is believed, however, that this will be remedied during the coming year, for the stockmen themselves are beginning to realize that one dry season may entail great loss.

Last fall a committee composed of representatives of this Service, the Reclamation Service, and interested stockmen investigated in the field the question of sheep grazing on the Tonto National Forest. At that time a certain number of sheep were allowed to graze on small areas within the watershed of the Salt River, with the understanding that if advisable they should be kept off after giving the owners sufficient notice. The results during the past year have caused the Reclamation Service to request that sheep be wholly excluded from these areas, and it will therefore be necessary to notify the stockmen that this must be done.

Grazing trespass.—There were 358 cases of grazing trespass, upon 86 of the National Forests. Of these, 181 cases of innocent and 125 cases of willful trespass were amicably adjusted by payment of the damages sustained; 42 cases, most of which occurred too late to be settled within the fiscal year, are pending settlement, and 10 cases were taken into the courts.

Advisory boards.—There were recognized 17 new advisory boards of local stock associations. The total number of such advisory boards is now 46. The advisory boards work in close cooperation with the local Forest officers, and settle many perplexing and complicated range questions. In nearly every instance the findings of the advisory board have been satisfactory both to the Service and to the stockmen.

The arrangement made last year through the advisory boards of the Snake River Stock Growers' Association of Colorado and the Carbon County Wool Growers' Association of Wyoming for sheep grazing on a large area of the Routt National Forest has enabled the sheep men to use these ranges in peace and in full harmony with their neighbors.

Properly organized and representative boards mean a more adequate understanding of the needs of the stock owners, greater ease of handling the work, better use of National Forest ranges, and a reasonable degree of home administration. It is the earnest wish of this Service to encourage such organization of all users of National Forests.

PERMITS.—On the Nevada and Zuni National Forests, and upon additions to older Forests, created after March 1, stock belonging to regular occupants of the ranges were allowed to graze free, without permit, during the season. Pay-grazing permits were issued as follows:

Pay permits for grazing on National Forests.

State or Territory.	Cattle, horses, and hogs.				Sheep and goats.		
	Permits issued.	Cattle.	Horses.	Hogs.	Permits issued.	Sheep.	Goats.
Arizona	1,599	225,181	10,765	425	195	491,040	21,090
Arkansas	27	541	18	176	1		19
California	2,808	168,308	8,715	3,535	312	340,534	20,348
Colorado	3,162	273,499	10,183		410	642,745	3,726
Idaho	2,116	112,511	7,593		848	1,782,978	
Kansas	96	13,598	230		1	356	
Montana	2,049	144,080	15,950		236	598,510	790
Nebraska	74	30,440	959				
Nevada	334	49,911	5,014		59	433,946	
New Mexico	2,137	124,312	7,309	252	748	476,118	93,723
Oklahoma	33	4,345	153	20			
Oregon	1,740	132,626	10,678	93	615	1,047,406	200
South Dakota	496	11,624	1,628				
Utah	4,449	118,059	6,799		1,283	905,446	
Washington	362	12,267	1,014		100	176,659	
Wyoming	681	70,083	3,011		266	783,960	
Total	22,163	1,491,385	90,019	4,501	5,074	7,679,698	139,896

The above is an increase of 187,243 cattle, 14,016 horses, 2,425 hogs, 718,779 sheep, and 13,704 goats over the previous year. In addition, free permits to graze 24,626 cattle, 2,826 horses, 33,005 hogs, 2,038 sheep, and 1,812 goats were issued to 5,109 users of the Ozark and Arkansas Forests, under special fire-fighting agreements. The increased number of stock grazed shows a very satisfactory improvement in the Forest ranges under proper regulation. The average number of cattle and horses to each permit was 71, and of sheep and goats 1,541, as against 70 and 1,655 last year. The reduced number of sheep and goats to each permit is due to division of grazing privileges among all applicants entitled to recognition. The receipts for grazing fees on account of the above permits, given on page 379, show an increase of 6.4 per cent over those of last year.

The successful working of the plan to allot grazing privileges for a five-year period, put into effect upon 7 of the Forests last year, led to its extension to 19 more Forests. This plan, originally initiated at the request of the stockmen, that their business might have greater stability, has given such good results that it will probably be applied to all National Forests as soon as the range divisions have been satisfactorily adjusted and the true carrying capacity of the ranges has been found.

Seven per cent of the approved applicants failed to use their permits, as against 8 per cent during the three preceding years.

There were issued 2,107 crossing permits, which allowed 55,901 head of cattle and horses and 4,131,190 head of sheep and goats to be driven across National Forests. This was an increase in permits of 45 per cent and in stock of 27 per cent. No charge is made for these permits, and no permits are required for small bands of stock which are driven along public highways, or which are not to be grazed upon the Forests en route. Every possible facility has been provided to enable stock to cross National Forest land in passing to and from their customary ranges, and to shipping points, without delay. The movement of stock across the Forests is practically unhampered, while Forest interests are entirely safeguarded.

There has been a noticeable gain in the number of paid and free permits allowing the construction and maintenance of pastures, drift fences, corrals, reservoirs, and other range improvements. The National Forests are the only parts of the public domain upon which these incidental uses of the range, so essential to the proper management of the range-stock industry, can be legally secured. The necessary inclosures and fences are maintained upon payment of fees lower than the tax rates would be on privately owned lands. Without such privileges National Forest stock raisers would have to invest large sums in patented lands.

Use of state lands.—The cooperative agreement with the States of Utah and South Dakota mentioned in last year's report devolves upon the Forest Service the regulation of grazing upon lands of these States lying within National Forests. In Utah the agreement was modified by the fixing of a minimum percentage of revenue to the State, and 49 permits were issued which authorized the grazing of 599 cattle and horses and 4,655 sheep and goats upon certain of the Forests on account of the State. Other States are considering similar agreements.

Where National Forests surround small bodies of land, title to which is vested in one of the States, as for example in the case of school sections 16 and 36, a State wishing to derive a revenue from the lease of such lands for grazing purposes is not able to do so to advantage because they are scattered. In leasing such land, protection of the productive power of the range and the forest is desirable from the standpoint of the State's interest. The Forest Service is already on the ground with an administrative system designed to meet these ends, and can easily apply this system to all lands within its boundaries. Under the cooperative agreements the State pays its quota of the cost of grazing administration on the combined state land and National Forests area, and issues orders for the same quota of the total number of stock permitted to graze on this area.

USE OF PRIVATE LANDS.—Owners or lessees of private grazing lands within National Forests may, if they so desire, exchange the right to graze their own land exclusively for free permits admitting to the Forest the number of stock the land will support under the Forest Service regulations. Thus holders of grazing rights on scattered or unfenced interior lands can graze their fair quota of stock on the range without the heavy expense to prevent trespass on the Forests to which they would otherwise be put. At the same time the best as well as the fullest use of the range is promoted. Private owners who prefer to use their own land exclusively are given free access to it through crossing permits when the land can not be reached by public highway; but the stockmen last year commonly chose the privilege of exchange. There were issued 1,157 such free permits for 51,912 cattle and horses and 295,162 sheep and goats in exchange for the right to graze 1,513,608 acres. On the other hand, 57 permits allowed 5,595 cattle and horses and 12,864 sheep and goats to cross into interior holdings, the right to exclusive use of which had been retained. The acreage, number of permits, and amount of stock under the exchange plan were all greater than the previous year.

Under a cooperative agreement with the Atchison, Topeka and Santa Fe Railroad Company similar to the agreements with the States of Utah and South Dakota already described, 26 permits issued upon certificates from the land commissioner of the railroad allowed the grazing upon the Manzano Forest of 165 head of cattle and horses and 7,513 head of sheep and goats, for which the company received the fee. These figures represent the net quotas and returns to the company after deduction of its share of the administrative expense.

PROTECTION AGAINST DISEASE.—The enforcement of quarantine regulations upon the National Forests in cooperation with the Bureau of Animal Industry continued as in preceding years, with effective and entirely satisfactory results. The relations of the two Bureaus have been exceptionally good, and the assistance rendered to the Forest Service was of great value to users of the National Forests.

Scab among the sheep and mange among the cattle were fought in certain of the States and Territories by requiring the stock under permit to pass the inspection of the Bureau before entering the Forests. The number of States in which an inspection of sheep was required was smaller than last year, and with strict enforcement of quarantine regulations it is probable that the National Forest ranges will soon be practically free from scab. The mange among the cattle is confined to so small an area in the Southwest that it is now practically local.

In Wyoming, at the request of the state authorities, the Bureau of Animal Industry took charge of an outbreak of lip-and-leg disease among sheep. The Forest Service cooperated by requiring inspection and a certificate of freedom from this disease for all sheep entering certain Forests.

In southern California, through the efforts of the Bureau of Animal Industry, the Texas-fever tick, which at one time infested almost every portion of the National Forests in the region, is now practically exterminated. It is hoped that one more season will completely eradicate this trouble from all the National Forests in that State.

The demand for blackleg vaccine has been less this year than for the two years past, but many requests for vaccine are received from Forest users. The use of vaccine, obtained through the Forest Service from the Bureau of Animal Industry, has been followed by an appreciable reduction in the losses from this disease on the National Forests.

The Forest Service has also worked in harmony with the stock sanitary boards of the various Western States in enforcing state quarantine regulations.

Protection against wild animals.—The following animals were destroyed within and immediately adjacent to the National Forests by 51 Forest rangers and guards, detailed to this work for an average period of one hundred and seven days:

Wild animals destroyed.

State or Territory.	Bears.	Lions.	Wolves.	Wolf pups.	Coyotes.	Wild-cats.	Lynxes.
Arizona	5	56	2		256	192	
California	31	8	1		202	38	
Colorado		3	1		73	11	1
Idaho	16		19	3	1,178	84	13
Montana	21		44	41	491	68	35
Nevada					45	14	1
New Mexico	14	28	64	7	322	116	30
Oregon	8		8		246	11	
Utah	8	1			331	37	1
Washington	3				8		
Wyoming	2		5	11	143		
Total	108	96	144	62	3,295	571	81

The value of the stock which these animals would have destroyed in one year, as estimated by the Biological Survey and by experienced stockmen, is at the lowest figures not much less than the total amount paid for grazing privileges during the year. It was impossible to meet the demand for hunters.

Prairie dogs were practically exterminated on large areas of Forest in Colorado, New Mexico, and Arizona, and it is anticipated that the land will shortly become productive of forage grasses and plants. Most of the Forests in the infested regions now have at least one man upon them who is versed in the work and can be assigned to it during the periods when it is most effectual. A widespread interest and readiness to assist has developed among stockmen.

Protection against poisonous plants.—In cooperation with the Bureau of Plant Industry, investigations of loss by poisonous plants were conducted upon a number of Forests. Many permittees were advised of the presence of dangerous plants and enabled to avoid loss. The poisonous properties of chokecherry leaves were determined. Experiment in the eradication of poisonous plants by various methods was practically confined to the Manti Forest, where the use of the range is very intensive. A botanical survey of a considerable part of this Forest secured valuable data. The work had a direct economic value.

Forage and pasture investigations.—The investigations of the year in reseeding overgrazed areas and introducing more valuable forage plants, carried on in cooperation with the Bureau of Plant Industry, comprises an extensive series of experimental studies upon the Wallowa Forest in Oregon, observations of several experimental plats in the Manti Forest in Utah, studies of the reseeding possibilities of alfileria and best methods of seed collection, and range examinations in several of the Forests. Many of the supervisors and rangers are conducting seeding experiments upon small areas. The benefits of the discovery of methods to restore western ranges to their former state of productiveness will extend far beyond the limits of the Forests.

The coyote-proof pasture in the Wallowa Forest, described in last year's report, demonstrated the practicability of fencing as a method of range utilization in high mountain ranges. It lowers the cost of handling, increases the carrying capacity of the range, reduces the rate of loss, and insures an increased lamb crop, heavier lambs, heavier mutton sheep, and an increase in wool production.

An experiment in the use of goats to open areas of chaparral was begun shortly before the close of the year on the Lassen Forest, in California, under a cooperative agreement with a goat breeder of that vicinity. The Forest Service allows the free grazing of 3,000 head of goats for a period of two years, while the permittee agrees to cut trails through the brush and pasture his goats in accordance with instructions. If successful, this experiment will greatly reduce the cost of forest planting on burned-over areas grown up to brush, while it holds out to goat breeders the hope of a possible solution of their present inability to get range.

GAME PRESERVES.—The extermination of noxious animals and complete protection of game upon the Wichita and Grand Canyon national game preserves has caused large increases in the number of the game birds and animals.

The Forest Service is cooperating with the Biological Survey in the construction of the fence around the bison preserve near Ravalli, Mont., but this preserve is to be entirely under the administration of the Biological Survey.

PERMANENT IMPROVEMENTS.

The fund appropriated by Congress for permanent improvements on the National Forests was $600,000, an average of about $4,000 to each Forest, and less than one-third of the amount called for by estimates of the supervisors. The need of trails, roads, bridges, and telephone lines in new and unsettled country, and of buildings to house the Forest officers, was very great. Many urgent projects had to be postponed for lack of money.

The construction work completed during the year comprised 1,670 miles of trails, 237 miles of roads, 1,418 miles of telephone lines, 64 bridges, 776 miles of pasture and drift fences, 43 miles of fire lines, and 528 cabins and barns. The maintenance of improvements drew appreciably from the fund, since trails and telephone lines in rough and wooded country require many repairs each year after the heavy winter storms.

Cooperation with States, communities, and individuals in the construction of roads, trails, bridges, telephone lines, and fences made possible a much larger increase of facilities than could have been provided from the Congressional appropriation alone. For example, a wagon road of 17 miles on the Coeur d'Alene National Forest in Idaho, built in coöperation with the county of Shoshone and the city of Wallace, cost approximately $20,000; the county contributed $10,000, the city $4,000, and the Forest Service $6,000. In southern California the citrus-fruit associations taxed the boxes of fruit shipped through their exchanges to raise cooperative funds for trail and fire-break construction on Forest watersheds which supply their members. Water companies and boards of county supervisors made contributions, and individual ranchers gave either money or work. The total amounted to $8,840, including $624 from the State of California, and the supervisor was obliged to refuse further offers because funds were not available for the Forest Service's share.

The value of fire lines was shown in southern California. One stopped a serious fire without human help, and another prevented a dangerous valley fire from extending into the mountains.

Part of the permanent improvement fund was used for drift fences, pastures, corrals, sheep bridges, reservoirs, counting chutes, and other miscellaneous range improvements which increased the carrying capacity of the ranges and gave them greater value to the permittees. In a part of this work stock associations and individual permittees cooperated. The fund apportioned to this line of work is entirely inadequate to meet the demands of the users of the different Forests.

FEDERAL COOPERATION.

In accordance with the agreement entered into between the Secretary of the Interior and the Secretary of Agriculture on January 22, 1908, as reported a year ago, forest work on the Indian reservations was throughout the year under the charge of the Forest Service. The aims of the agreement were to protect the great amounts of timber now standing, and worth some $75,000,000; to secure to the Indians the full value of timber sold through oversight of all lumbering operations and sales; to determine upon what lands permanent forests should be maintained; and to provide for the systematic care and improvement of the forests on such lands. It was provided that all salaries and other expenses of the work should be borne by the Indian Office, which was also to prescribe the policies to be followed in all matters affecting the welfare of the Indians, as, for example, the employment of Indian labor and protection of the Indians from intoxicants. All the direction of and responsibility for forest work was placed upon the Forest Service.

Work under this agreement was carried on throughout the year, but could not be extended to all of the reservations with forested areas because the Indian Office found itself unable to allot the necessary funds. On the Bad River, Flathead, Grand Portage, Lac Courte Oreille, Lac du Flambeau, Leech Lake, Menominee, and Red Lake reservations 190,000,000 feet of timber, worth over $1,000,000, was cut under the supervision of the Forest Service. On the Klamath, Pine Ridge, Rosebud, and San Carlos reservations timber cuttings made by the Indians for their own use and for agency purposes were supervised, with a large saving of unnecessary waste.

Fire patrols were organized on the Coeur d'Alene, Klamath, Menominee, Pine Ridge, Rosebud, and San Carlos reservations. In August and September, 1908, the most disastrous fires for many years visited the Lake States region. On all sides of the Menominee Reservation in Wisconsin forest fires swept across the country, but the protective force organized by the Forest Service fought and kept back every fire which came near the reservation lines, so that there was practically no damage from fire on the reservation. On the Coeur d'Alene Reservation, in Idaho, a bad fire, with a front of 6 miles in an inaccessible country, was extinguished after thirty days' work. In the spring of 1908, before a protective force was organized, fires did over $70,000 damage on the Pine Ridge Reservation. A patrol system was established on this and the Rosebud Reservation in the spring of 1909, and practically no timber was destroyed.

On the Menominee Indian Reservation a sawmill of 100,000 feet daily capacity, constructed under the supervision of the Forest Service, began to operate on February 1, 1909. On June 30 about 10,000,000 feet of lumber had been manufactured from the logs cut from blown-down timber. Radical changes in the logging and business conduct of a large lumbering operation, in progress when the Forest Service took charge, were made with a view to reducing waste. Plans for the conservative logging of other portions of the reservation were completed.

Examinations were made of forest lands within the Coeur d'Alene, Flathead, Hoopa Valley, Klamath, Lac Courte Oreille, Leech Lake, Nez Perce, Northern Cheyenne, Qualla, Red Lake, Siletz, and Spokane reservations, and planting plans were outlined on five reservations in Oklahoma.

Soon after the close of the fiscal year the Indian lands cooperative agreement was terminated by the Department of the Interior.

Examinations of timber reservations were made, plans of management prepared, or timber sales supervised for the War Department at Forts Meade and Wingate, Picatinny Arsenal, the Presidio of Monterey, and Middle Point, Tillamook Head, Three Tree Point, Saunderstown, and Sturgeon Bay Military reservations; for the Navy Department at Charleston and Norfolk navy-yards; and for the Department of Commerce and Labor at Bois Blanc, Cheboygan, and Grand Marais Light-House reservations.

STATE COOPERATION.

State cooperative work increased during the year. In New Hampshire the study of forest taxation, begun in the spring of 1908 in cooperation with the State Forestry Commission, was completed. This was the first thorough study of the actual working of present methods of taxing forest property ever made in the United States. A tax law was worked out, but did not pass the legislature. The report also dealt with the efficiency of the fire laws and made recommendations which were in the main adopted by the state legislature.

The study of forest conditions in Kentucky, begun in the summer of 1907 in cooperation with the state board of agriculture, forestry, and immigration, was continued through the season of 1908. Approximately 12,000,000 acres have been examined and mapped since the work began. A proposed forest law for the State was prepared.

A preliminary examination of forest conditions in Alabama, made in cooperation with the state commission of forestry, included a description of the forest conditions by regions, a discussion of the different forest problems in the State, and detailed recommendations for the improvement of the present fire laws, the appointment of a state forester, the restriction of turpentining, the regulation of lumbering operations, and a general forest policy for the State. A similar study was made in Florida. In Illinois a study made in cooperation with the State Laboratory of Natural History investigated forest conditions in typical regions of the State, worked out plans for the perpetuation of the forest types, and developed the essential features of forest legislation needed in the State.

In Michigan cooperation with the State Forestry Commission procured a rough estimate of the standing timber, the proportions of cut-over, cleared, and forest land, and the extent and seriousness of recent forest fires, in the light of which the fire and tax laws were discussed and recommendations for state and private forest reserves were made. State cooperation with Oklahoma resulted in a preliminary study of existing timber resources and the field for forest planting, and with Utah in the supervision of some timber sales on state land within National Forests.

Cooperation with States in the regulation of grazing on state lands within National Forests has already been reported on page 393.

As the policy which governs National Forest administration has become more clearly defined in practice and better understood by the western public, a wide field for cooperation begins to appear. The Forests are maintained not to serve a federal interest unrelated to or in conflict with the interests of individual States, but to serve the national interest through a work which from first to last directly furthers the welfare of western communities and States. The field is one which creates a true partnership of interests. Because of the interstate relations and the national scope of the problems involved it pertains to the Nation, yet it concerns fundamentally the best use of the natural resources of each State.

State lands within National Forests are one illustration of the opportunity for such a partnership, which, however, should not be regarded as confined to the state holdings merely. Broadly speaking, the interests involved are the same whether ownership of the land rests with the State or the Nation. The same opportunity to serve the public welfare exists in either case, and the best use of one should be the best use of the other also. By a joint management which safeguards the right of both the State and the National Government to exercise their proper prerogatives, but in a spirit of hearty cooperation for a common end—the welfare of the people—a wise, efficient, and economical administration of the land which, whether state or national, belongs to the people, should be possible.

An obstacle in the way of working out plans for such cooperation with some of the States is created by a legal question which has come up as to the ownership of certain lands. The enabling acts of North Dakota, South Dakota, Montana, Washington, Idaho, Wyoming, and Utah, in connection with the grant of land for the common schools, reserved for school purposes sections 16 and 36 (in Utah 2, 16, 32, and 36), whether "surveyed or unsurveyed." By several decisions of the Secretary of the Interior (the latest of which was rendered September 30, 1909) it has been held that, where school sections are included within a National Forest before approval of survey, the title thereto will not vest in the State until the reservation is extinguished, the State, meanwhile, having the right to select an equal area elsewhere as indemnity. The first part of the Secretary's ruling upon the law is disputed by some of the seven States above mentioned, and a final determination of the matter can, of course, be had only through the courts. In the meantime the Forest Service is specifically bound by this last decision to regard the title to the land as still in the Government, and to administer the land accordingly.

Presumably Congress will grant some measure of relief if the contention of the States falls. Whether this relief should take the form of an actual grant of all the school sections, of a right to some more advantageous form of indemnity selection, or of exchange for a solid body of present National Forest lands, will of course be for Congress to decide.

Other fields for cooperation between the Forest Service and the States include joint action in dealing with the forest-fire problem, joint enforcement of the game laws and provision for the increase of game where this is desirable, and joint action to stamp out disease among stock through enforcement of sanitary regulations prescribed by state boards. Indeed, the field is capable of almost indefinite expansion.

GENERAL INVESTIGATIONS.

The public welfare requires that we should know both how to make all forests, public and private, produce the most of what we need and how to make the most of what our forests produce.

The first end is the aim of silviculture. Like field crops, the forest crop responds in character and amount to the cultural treatment given it. To bring about better forest culture the Forest Service studies the conditions which govern the character and rate of forest growth throughout the United States. It also, to promote the best use of the material which the forest puts at our disposal, studies the uses to which this material is or might be put. Under these two heads, silvical studies and studies of forest products, falls the general investigative work of the Service.

SILVICULTURAL STUDIES.

Through cooperative work with private owners the Forest Service gathers practical information concerning forest management and planting for general use. There were made 92 field examinations of about 700,000 acres of private forest lands in 26 States. New applications were received from 61 private owners in 23 States. A working plan was made for 75,000 acres of coal company forest land in the Birmingham district of Alabama. The company, which uses nearly 20,000,000 board feet of timber annually, desires to manage its land for a sustained yield. There were made planting plans for about 3,000 acres of private land in 8 States. In cooperation with private owners, a study of the possibilities of the eucalypts was made in southern Texas.

Cooperative experiments in nursery and planting work were carried on with 5 state experiment stations, with Berea College in Kentucky, with 2 state foresters, and with the forester for Hawaii.

These experiments seek to determine the trees best adapted to regional use. Among the most important experiments is the sowing in Maryland of loblolly pine, a tree of great promise for reforesting sandy land in the Central Atlantic and Southern States.

A study of the effect of wind-breaks on farm crops covered the States of Nebraska, Kansas, Iowa, and Minnesota, and obtained results which apply to a great extent also to the Lake States, the Northwest, and the Southwest. It was proved that in the absence of natural barriers to check the wind's force and within certain limits of width, wind-breaks pay for the ground they occupy by causing an increase in the yield of crops to their leeward. Studies of cypress and the various species of ash furnished information regarding the present stand, annual consumption, growth, yield, reproduction, and proper management of these forest trees.

A plan for volunteer observations on the time of leafing, blossoming, and fruiting of the most important trees of the United States enlisted more than 2,000 teachers as local observers. These observations will contribute in an entirely novel way to our knowledge of climatic conditions. They are really meteorological observations, in which the life processes of trees furnish the record. Such observations furnish a means of deciding what kinds of trees are suited to any locality.

Seed testing during the year included tests of the seed collected by the Forest Service in 1908, tests of various methods of germination, tests of seed samples placed in storage in 1906, the preparation of samples for a new series of storage experiments, and a few tests of seed samples for private persons. The results obtained have immediate practical utility for the National Forest planting work. Twenty-nine silvical leaflets were prepared and published.

Study of the characteristics of pine resins in cooperation with the University of North Carolina, concluded during the year, secured further data of value to the turpentine industry. The forest herbarium and wood collection were considerably increased, and the distribution of North American trees was more fully studied and mapped.

STUDIES OF FOREST PRODUCTS.

While silvical studies aim at increasing the productive power of the forest, the studies of forest products aim at economy in the use of what the forest creates. With better use a given amount of raw material goes further. The practical result is the same as though the forest had been made to produce more. Waste of wood material in the United States is very great. Through preventable decay, ignorance of the physical properties or best methods of handling different kinds of timber, and other causes, the wood fails to render its best service, and the result is an unnecessary drain on the forest. There is also a heavy loss in wood which is destroyed through decay or other natural causes in the forest itself. Altogether, though we grow yearly only one-third the wood we use and are nearing the end of the surplus which is drawn upon for the other two-thirds, we give far too little heed to economy of use.

The Forest Service seeks to promote economy of use, first, through learning and making known the actual situation as to demand and supply of forest products; and, second, through investigations to discover how forest products may be put to better service. To the extent that a profit can be secured from what is now wasted, the returns to the forest owner are increased and investment in the business of producing timber is made more attractive. The effect of discoveries of this kind is both to cheapen the present selling price of the primary product and to broaden the opening for forest management.

The general problem of promoting the best use of wood gives rise to three classes of studies: Studies of present supplies, consumption, uses, markets, and prices; studies of the natural qualities of wood and of methods of handling and using it, that it may give better service; and studies of waste and its possible reduction or utilization.

STATISTICAL AND MARKET STUDIES.

The first necessity for wise use of our forest supplies is accurate knowledge as to what there is, how fast and for what purposes it is used, what it brings, and how fast it is being reproduced. Although our knowledge of these facts is still far from satisfactory, each year has marked a distinct advance toward certainty as to where we stand. The statistical work of the Forest Service has had a far-reaching effect in bringing lumber and other manufacturers into hearty sympathy with the Service and in giving them a better understanding of the meaning of forestry. In almost all important association meetings of the wood-producing or wood-using industries discussions of forest problems now occupy a prominent place. The principal manufacturers or users in every line report their production or consumption promptly, recognizing the value to them of the statistics gathered.

Annual statistics of forest products are collected in cooperation with the Bureau of the Census, with the assistance of the National Lumber Manufacturers' Association. The Bureau of the Census keeps the lists of names, sends out the schedules, and tabulates the replies. Bulletins interpreting the results are written in the office of Forest Statistics and published by the Bureau of the Census.

About 52,000 schedules sent out covered forest ownership and protection, forest taxation, mill operations, forest areas, forest fires, forest planting, production and uses of timber, forest cover and water supply, the use of wood for fuel, and related subjects. The returns from these, supplemented by those from 48,000 schedules upon firewood, post, and rail consumption mailed by the Bureau of Statistics and tabulated by the Bureau of the Census, together with information already in the Service files, furnished information which was embodied in papers for the report of the National Conservation Commission. The material secured will also be used in a number of Forest Service publications.

The kind and quantity of wood preservatives used in the United States was learned for the first time through inquiries sent to all the wood-preserving plants. The replies showed that 57,000,000 gallons of creosote were used in 1908, of which two-thirds was imported.

An attempt was made to compile a complete statement of the loss by forest fires last year, but it was found impossible because few of the States have any adequate provision for recording or preventing forest fires.

A special inquiry made in cooperation with the National Hickory Association into the annual consumption of hickory yielded valuable though incomplete information and laid the basis for fuller inquiry next year.

A study of the relation of the tariff to the lumber industry led to conclusions which were presented by the Forester to the Ways and Means Committee of the House of Representatives on February 24 and later summarized in a letter to the chairman of the committee.

On July 1, 1908, the Forest Service began to publish a monthly wholesale price list of lumber in twenty of the principal markets of the United States. Previously no authoritative record of the selling prices existed and the lumber industry was the only important industry of the country without such a record for its product.

This record is needed in the interest of the lumber trade itself, but still more in the interest of the public. The lumberman occupies a somewhat peculiar position. He supplies a public necessity under conditions which make combination for a monopoly profit increasingly possible as the supply dwindles. To promote cutthroat competition means the promotion of wasteful use and of the exhaustion of supply, but diminished competition means danger of extortionate prices. Both present and future must be provided for; neither should be unduly sacrificed to the other. The only alternative to public ownership of all forests as the means of escape from ill-considered reduction of the supply on the one hand and unreasonable charges on the other is publicity and, where necessary, regulation in the public interest. Progressive lumbermen are themselves coming to recognize the need of Government regulation of their business. If the public interest is to be fully served the end sought must be neither too cheap prices through destructive competition nor extortionate prices through monopoly control of forests for private profit, but fair and reasonable prices, taking account alike of the present, the future, and the rights of owners. In securing and publishing the figures of lumber prices the Forest Service is creating the means of judging whether the public is fairly treated, so that if the need for action arises measures of regulation may be applied intelligently.

The work is now on a firm basis of cooperation with the wholesale lumbermen. A few markets are yet to be added to round out the work for the entire country. To give it its maximum value to the public and to the lumber industry, it is desirable to bring out the prices at the mill for representative grades and for mill run of lumber for the leading commercial woods. Plans have been made to obtain and publish this information quarterly. The mill prices include cost of stumpage, cost of manufacture, and profit of the manufacturer. The wholesale prices include, besides these items, the cost of transportation, handling in the market, and profit of the wholesaler. The two together will give the basis for a complete analysis of the cost of manufacturing, handling, and selling lumber.

To take its part in solving the problems connected with the better utilization of our forest products, the Forest Service must keep in touch with and abreast of the industries which use wood. To bring this about studies are made of the chief lumber markets of the country and of the wood-using industries, in order to know their requirements as to quantity, form, and kind of wood. In the West this work has been carried on with especial reference to the products of the National Forests. Plans have been made for systematic cooperation with several States. The work both locates the problems of the wood-using industries, in so far as they relate to timber supply, and aids the State to formulate a wise timber policy by showing how much wood must be produced to keep the industries going.

The study of wood uses is being gone into fully. This project covers the past, present, and prospective uses of the commercial timbers of the United States, with their sources of supply, quantities available, and waste. Special attention is also given to the properties which fit woods for particular purposes. Eighteen important and thirty-four minor species have been covered.

WOOD PRESERVATION AND TIMBER TESTS.

A most striking advance took place during the year in protecting wood against destructive agencies. By treatment with preservatives, such as creosote and zinc chlorid, wood is made to a greater or less degree immune from fungi, insects, and marine borers. These now destroy annually some 8,000,000,000 feet of timber in the United States. During 1908 57,500,000 gallons of creosote and nearly 19,000,000 pounds of zinc chlorid were used in treating timber, a great increase over any previous year. Probably 1,375,000,000 board feet were treated, or about 15 per cent of the timber which should be treated. The number of treated ties in 1908 was 23,776,060, against 19,856,000 in 1907, although 27 per cent less ties were used. Preservative treatment is making possible the use of many woods neglected in the past. This means the saving of the more valuable timbers for better uses.

Corresponding to these gains, interest in timber treatments has broadened to all parts of the field. Railroads, telephone, power, and mining companies, and even small users like farmers, are coming to regard preservative treatment as a necessity.

The Forest Service has had a notable part in this advance. The greater amount of its work has been to make known to the public the practical value of preservative treatments. To demonstrate the practicability of treating National Forest timbers, small plants were operated for a part of the year on the Holy Cross and Black Hills National Forests. The Black Hills plant was taken over during the year by the Homestake Mining Company, enlarged, and put into commercial operation under Forest Service supervision. Timbers for permanent telephone lines and fences on the Forests are treated by the Service. Inexpensive plants for small users were designed and put to trial in several places for treating fence posts and shingles. Treated fence posts were set in experimental lines to test their comparative value. In this work the Service cooperated with excellent results with the experiment stations of Maryland, Iowa, and South Carolina, the University of Minnesota, the Bureau of Plant Industry, and the firm of S. Jacobs & Sons, Brooklyn, N. Y.

In similar manner, but on larger scale, the Service cooperated with mining, railroad, telephone, and lumber companies, the cooperator paying all expenses of the work, including salaries, while the Forest Service furnishes the men and reports the result.

Plants were designed, installed, and experimentally operated and timber policies recommended for the Philadelphia and Reading Coal and Iron Company, the Coal Mining Department of the Delaware, Lackawanna and Western Railroad Company, the Hercules Mining

Company, at Wallace, Idaho, and the Bunker Hill and Sullivan Mining and Concentrating Company, at Kellogg, Idaho. The Philadelphia and Reading Coal and Iron Company, on the advice of the Service, installed twelve portable sawmills to saw sound lumber from partially decayed mine timber formerly burned as useless, at a cost of about $15,000 and with a saving of several thousand dollars per month. Treating plans, some of which are now in effect, with the prospect of an important saving in wood consumed, were formulated for the H. C. Frick Coke Company; the Spring Valley Coal Company, of Illinois; the Tennessee Coal and Iron Company; the Indianapolis, Columbus and Southern Traction Company; and the North Louisiana Telephone Company.

In cooperation with the Great Southern Lumber Company, of Bogalusa, La., the Forest Service sought means to prevent, by the application of chemicals, the sap-staining or "bluing" of freshly cut lumber, which costs southern lumber companies more than $6,000,000 annually. A treatment was found which appears to be of value, and its commercial application is now being worked out. A plant was also designed for this company to enable timbers, such as poles, ties, and piling, to be given a preservative treatment as a part of the lumber operation.

Investigative work in cooperation with five electric light, railway, and power companies in southern California worked out methods of handling and preserving western yellow pine and red cedar poles, together with designs for a commercial pole-treating plant.

Plans were prepared for a plant authorized by the War Department to treat ties and fence posts, which provide for a combination open-tank at Picatinny Arsenal.

Agreements were signed for work in cooperation with the Gulf Arm and Creosoting Company, of Hattiesburg, Miss., and the Alabama Wood Preserving Company, of Birmingham, Ala.

In investigating the scientific problems involved in wood preservation, reliable and simple methods of analyzing creosote and zinc chlorid and determining their presence in treated timbers, and of determining the effect of preservatives on the strength and other properties of wood, were found. Many urgent fundamental problems remain to be solved.

In the study of wood fungi the Service had efficient cooperation from the Bureau of Plant Industry through its Laboratory of Forest Pathology.

Tests of the strength and other important properties of American woods in the form of construction timbers and in such manufactured forms as buggy shafts, wagon axles, and harvester poles also showed how the strength of wood is affected by such factors as locality, rate of growth, or part of the tree.

Testing laboratories were operated in cooperation with Yale and Purdue universities and with the universities of Colorado, California, and Washington. The University of Idaho correlates its work and methods in testing with those of the Forest Service.

Tests were made of treated longleaf pine and Douglas fir bridge timbers to determine the effect of treatment on the strength of the wood in cooperation with the American Railway Engineering and Maintenance of Way Association; of various species of hickory, to determine their relative values, in cooperation with the National Hickory Association; of redwood, to determine its value as a structural wood, in cooperation with the California Redwood Association; of dead timber from the National Forests of Colorado, to determine its value for mine purposes, in cooperation with several mining companies in Colorado; and of the effect on strength of various methods of drying.

Tests on joists cut from green and fire-killed Douglas fir at the laboratory at the University of Washington formed part of the Forest Service exhibit at the Alaska-Yukon-Pacific Exposition.

UTILIZING WOOD WASTE.

In attacking the vital problem of wood waste the Forest Service had the aid and hearty support of wood-using industries of every kind. No one solution of this many-sided problem will meet the need. The conditions presented by each industry must be the starting point for a patient study of possible economies. In certain cases a change in the character of the product will serve the desired end. For example, sawed railroad ties in place of hewed would save the waste of 280,000,000 cubic feet of wood annually. In others the problem is to utilize apparently unavoidable waste through by-products. Or the problem may be to find out for what new uses a particular kind of wood is fitted.

The yearly waste of wood through the death and decay in the forest of uncut trees is enormous. Many millions of feet of scrub pine in the East, tupelo gum in the South, and Engelmann spruce and several firs in the West go to waste because, with our present knowledge, they are of little use. Such woods, forming a large part of our timber supply, are studied and tested by the Forest Service. Engelmann spruce, lodgepole pine, Douglas fir, grand fir, scrub pine, tupelo, white fir, black gum, incense cedar, red maple, beech, and sycamore were tried for pulp. Engelmann spruce, white fir, and lodgepole pine have fiber that compares favorably with eastern spruce. In part as a result of Service tests new woods are coming into use in the western pulp mills.

Another means of lessening the drain of the paper-making industry upon existing forest supplies was sought through tests of cornstalk, rice straw, flax straw, bagasse, and cotton stalk fibers, made in cooperation with the Bureau of Plant Industry. It was found that a good, easy-bleaching pulp can be produced from rice straw and cornstalks, but much additional work is necessary to prove that paper can be made commercially from these materials. Cotton stalks do not produce an easy-bleaching pulp, and would find use only in cheap, dark papers, while the short fiber obtained gives little strength unless mixed with some longer-fibered material. Flax straw was found to cook with great difficulty, to require a very high percentage of bleach, and to screen badly, but could possibly be used for cheap wrappers.

Again, great waste takes place in wood discarded in the process of manufacture. Besides about two thirds of the wood cut for lumber, a large part of what is cut for railroad ties, poles, piles, mine timbers, cooperage, and other uses is lost in this way. Yet the material lost is full of valuable substances. It is estimated that the sawmill waste of yellow pine in 1907 would have yielded 36,500,000 gallons of turpentine, or 6,000,000 gallons more than the total production of gum turpentine in 1905. At 30 cents per gallon this would mean a value of nearly $11,000,000. The waste of beech, birch, and maple is sufficient to produce 90 per cent of the wood alcohol and acetate of lime manufactured in the country, and if so used would yield a product worth annually nearly $7,000,000. Some progress is being made in learning how to stop such wastes. During 1908 there were made, from waste yellow pine principally, 1,995,728 bushels of charcoal, 505,800 gallons of turpentine, 304,979 gallons of pine oil, and 966,675 gallons of tar, and at least one plant is making a satisfactory grade of wrapping paper from yellow-pine waste.

Close attention was given by the Forest Service to the problem of utilizing this valuable material now wasted. One of the greatest difficulties in the way of using yellow-pine waste is to obtain a pure, merchantable turpentine. During the year a very complete and carefully constructed turpentine-refining still was built for the Service. It is being used in standardizing grades of wood turpentine, and will undoubtedly give information of great value in distillation methods. Two national paint and varnish associations appointed committees to cooperate with the Service in testing the products practically, while turpentine manufacturers in the South supplied materials.

A special appropriation of $10,000 was used to obtain statistics of the naval-stores industry and to examine into its future supply. The results strengthened the belief that in the future we must look more and more to mill waste for the turpentine supply.

The loss of sulphite liquor from pulp mills, pyroligneous acid from the distillation of resinous woods, and turpentine from dry kilns are other examples of the problems in preventing the waste of products which await consideration.

DIFFUSION OF INFORMATION.

In all its investigations the Forest Service has steadfastly aimed at usefulness. Studies are made not to advance science in the abstract, but to open the way to better practice. But right practice in putting all our forest resources to the best use depends on a thorough public comprehension both of the value of forests and of the methods which will get the most out of them. The work of diffusing information is no less important than that of gathering it.

During the year the Forest Service continued the diligent effort of the past to spread widely an understanding of what forestry means when put into actual practice and of the best ways to use forest resources. This was done through (1) advice to individuals, given on the ground or by correspondence; (2) the preparation and distribution of publications; (3) public addresses; (4) the loan and sale of lantern slides, pictures, and other material for the use of lecturers, writers, and others; (5) cooperation with teachers, public-school officials, and others connected with educational work; (6) exhibits at expositions; and (7) preparation of official information concerning forestry and the work of the Forest Service in brief typewritten or mimeographed statements, in conformity with the provision of the Agricultural Appropriation Act of 1909 and the decision of the Attorney-General quoted in the report of last year. These statements were given wide circulation by the newspaper press of the country.

The cost of the diffusion of information reported on page 371 includes, as nearly as possible, all expenditures for the above lines of work, with the exception of the first, the cost of which can not be segregated from that of the several offices which answered the great number of requests for information on technical subjects. The amount reported, $82,790.02, was about 2 per cent of the total expenditures of the Forest Service from appropriations. Exclusive of the cost of purchasing stencils for addressing machines, bought near the close of the year to cut off in future the cost of addressing envelopes by hand, the amount spent shows an increase over the previous year of 16 per cent. The greater part of this increase, however, is due to a change in the method of prorating against different lines of work the expenses of general maintenance and administration of the Service. In other words, the actual cost of the work of diffusing information was nearly the same as for the previous year.

During the year 63 new publications and 102 reprints were issued. The total distribution of new publications was 1,237,100, and of reprints 259,650.

The Forest Service mailing list was carefully revised and the number of names brought up to 750,000. The addressing machine bought and installed near the close of the year reduced the clerical force of the Service by 30 persons.

Members of the Forest Service, exclusive of forest officers, delivered during the year 359 public addresses. These were given, in response to requests, before gatherings of National Forest users, trade associations of wood users and similar bodies, chambers of commerce and boards of trade, meetings of farmers, educational assemblies, and the like. Except as these addresses were made in the course of travel necessitated by other official duties, the expense incurred was usually reimbursed. Only a minor part of the requests for addresses could be granted.

There were loaned or sold to persons outside of the Forest Service 4,995 lantern slides. Loaned sets of slides are usually accompanied by outlines to insure effective educational results. The collection of slides was overhauled and added to.

In its cooperation with teachers and others connected with educational work the Forest Service markedly enlarged its activity. A widespread desire now exists among teachers and officers of public instruction to utilize in school courses, usually in connection with nature study, geography, or agricultural education, some of the material of forestry and information concerning our forest resources. This opens an exceedingly valuable avenue for diffusing useful knowledge about the best use of forests, but careful preparation of the material is necessary in order to give it a form suited to educational use. In the single State of Iowa, as a result of the work of the Forest Service, forestry was introduced into 114 public schools. Four public schools in the city of Washington cooperated with the Service to devise a good method of utilizing forestry in the graded school course. Similar work for high schools was carried on in Philadelphia. Courses of study were prepared for other schools. Many teachers and pupils elsewhere volunteered as observers for the collection of phenological data. A circular letter to all school superintendents secured the names of schools in which forestry is now taught. Many photographs and some maps were supplied for school use, and three commercial firms were supplied with prints from which to make lantern slides for the same purpose.

An exhibit of the Forest Service at the Alaska-Yukon-Pacific Exposition showed by transparencies, bromides, maps, diagrams, and other material the activities of the Forest Service, the effects of right and wrong use of American forests, and forest products problems. Exhibit material was loaned to the New York Forest, Fish and Game Association, and also, on the request of the governor of Idaho, to the Idaho commission for use in the Idaho building at the Alaska-Yukon-Pacific Exposition.

WORK FOR THE ENSUING YEAR.

The work planned for the ensuing year will be outlined under the five main administrative divisions of the Forest Service, the Office of the Forester, and the branches of Operation, Silviculture, Grazing, and Products.

OFFICE OF THE FORESTER.

The Office of the Forester includes, besides the Forester and Associate Forester and their inspectors, the Law Officer, Editor, Dendrologist, and Statistician. These officers, with the Assistant Foresters (chiefs and assistant chiefs of branches), form the Service Committee, which, under the Forester and Associate Forester, has jurisdiction over questions of general administrative policy.

The legal work of the Forest Service includes advice given the Forester, the branches, and the District Foresters on contracts and all questions of law which arise in the conduct of Service business; cooperation with the Department of the Interior in public-land law questions on National Forests; advice upon request from state authorities and individuals concerning state forest legislation; and investigations in the field of forest law. The work of the ensuing year will continue the work of the past along these lines.

The Editor will, during the ensuing year, have direct administrative charge of all the work of the Service in the diffusion of information to the public, except that done through correspondence and advice on the ground by technical offices. Administrative charge of all printing and publishing activities, public addresses, the loan and sale of lantern slides and other illustrative material, cooperation with educators, and public exhibits will be transferred from other offices to that of the Editor. Greater activity in the publication of technical forest literature is planned, but without abatement of past efforts to popularize and spread widely practical knowledge at every possible opportunity. Publications summarizing the results of past work in various fields, and others utilizing new information gathered in the calendar year 1908, will serve the latter purpose. Requests for public addresses before other bodies than National Forest users will, as a rule, be refused unless all expenses are reimbursed. An exception will be made, however, in the case of teachers' associations, state educational conventions, and similar opportunities to advance the work in cooperation with schools. This work will be expanded.

The Dendrologist will continue investigations of the geographic distribution of American trees and of related forest problems.

The statistical work of the Service will include the gathering of data concerning forest fires and investigations in connection with imports and exports of forest products, as well as the continuation of past studies of production, consumption, and existing supplies in the United States.

BRANCH OF OPERATION.

Improvement work will be concentrated on building and improving roads, trails, telephone lines, and other means of communication on the Forests. These are absolutely necessary for the protection of the Forests against fire. The experience gained in the past three years will make possible a high standard of economy and efficiency. Cooperation will be carried on with counties, communities, and individuals in road, trail, and bridge construction, and with stockmen in building and improving drift fences and watering holes.

The detailed examination of National Forest boundaries begun in May will be finished by the close of the present field season. The data obtained will be used to make any needed corrections in the present boundaries, in so far as this can be done under existing laws.

During the coming year a detailed classification of the lands within the National Forests will be begun, in cooperation with other Government bureaus.

Special attention will be given to the improvement of the Forest personnel. Examinations for forest rangers will include a basis for a rating on education as well as experience, since many rangers have been found to lack sufficient education to handle the business which is now intrusted to them, or to be qualified for promotion to be forest supervisors. Forest officers will continue to be detailed for temporary service in the district offices, while meetings of supervisors and rangers and special ranger courses will provide for instruction in the better handling of Forest business.

Cooperation with States, communities, and individuals against fire will be carried on more extensively than in the past. Negotiations now pending with railway lines for cooperative fire agreements will be concluded early in the year. Uniformity in the statistical records of all the districts will be secured by having all periodic reports compiled in identical form on standard sheets for the district atlases and the figures summarized for the Service Statistical Atlas from duplicates forwarded to Washington.

Important changes to eliminate duplication in accounting records will be made. The Washington office will keep only general records of receipts and expenditures in the six National Forest districts. The district offices will in turn leave to the offices of supervisors the detailed accounts of expenditures on projects and lines of work upon the Forests. This change will result in uniform accounting records throughout the Service and reduced routine work.

BRANCH OF SILVICULTURE.

Sales of National Forest timber will be made wherever it is possible to remove mature timber and make room for a new crop without jeopardizing future supplies or disposing of timber at an undue sacrifice. To gather information as to where sales should first be made, to what extent and in what way timber should be sold, and how it may best be removed, reconnaissance studies will be pushed extensively. The information secured will help the would-be purchaser as well as the Forest Service in selling timber. It is evident that with recovery from the business depression the volume of sales will materially increase.

Extensive studies on cut-over areas will seek an authoritative basis for calculating growth after lumbering. Thus far most growth tables have been based on conditions in virgin forests, which give inaccurate data for computing growth after the forest is opened up. Yield tables will be prepared for a number of western species. Results obtained from different methods of cutting will be studied, as well as the influence of forests upon stream flow, the breeding of trees, and differences in growth of trees due to the source of the seed.

Experimental planting and sowing and the introduction of new species will be pushed forward.

At least one more experiment station will be established, probably in District 2.

Cooperation with other departments will continue on request for technical advice or supervision of timber work.

In state cooperation the study of forest conditions in Kentucky will be continued and probably completed. A detailed study of the forest resources of Illinois will be started. Cooperation with the North Carolina Geological and Economic Survey will begin in a study of the forest conditions of the western part of the State. An investigation of the woodlot conditions of Virginia will aim at helping the farmers of the Piedmont region to protect and make better use of their old field timber. Preliminary examinations of forest conditions, similar to those in Alabama and Florida, will be made in South Carolina and Mississippi, and probably in Georgia, Tennessee, and Ohio also. Cooperative experiments in nursery and planting work will be continued with state institutions and with Hawaii. The study of forest taxation in several States, including Wisconsin and Kentucky, will probably be made along the lines of the New Hampshire study.

The number of applications for the examination of private forest land continues to increase. Cooperation with large mining, lumber, and other wood-using companies which own forest land opens a field for advancing forestry which should not be neglected. Several important working plans will probably be made during the ensuing year. Other studies of forest planting and forest trees will be conducted as opportunity arises.

BRANCH OF GRAZING.

During the year data concerning the prices charged for grazing privileges upon military and Indian reservations, Reclamation Service withdrawals, and state, railroad, and other privately owned tracts of land, in comparison with the fees charged upon National Forests, will be collected. The information will furnish a basis for equitable adjustments of the grazing fees upon different Forests and for different kinds of stock.

The killing of predatory animals will be continued upon an enlarged scale. It is planned to employ hunters upon approximately 100 Forests for an average period of three months. This will double the work of 1909 along this line and will substantially satisfy the demands of stockmen.

In range development, besides the studies now under way of summer ranges, studies of year-long ranges will be made. The object will be to determine whether the valuable forage grasses and plants with which the now depleted ranges were originally stocked can be restored, either by natural reseeding, improved methods of handling the stock, or by artificial reseeding with native and introduced grasses. Observations at the coyote-proof pasture and the other inclosures will be discontinued after the close of the calendar year, and new investigations will be started in other parts of the West. Arizona, New Mexico, and Colorado offer especially desirable fields for work of this character.

BRANCH OF PRODUCTS.

The laboratory investigations which form the most important part of the work of the Branch of Products will henceforth center in Madison, Wis. For several years the need of a general forest products laboratory has been increasingly felt. It was plain that decided advantage would be gained by having such a laboratory connected with a prominent university. The question was accordingly taken up with the several universities most advantageously situated. Attractive proposals were made by nearly all of them. The proposal of the University of Wisconsin was accepted as providing, all things considered, the most advantageous conditions. Under the agreement the university is to provide a laboratory building constructed in accordance with plans furnished by the Service, and power, heat, and light. The Forest Service is to furnish all machinery and the testing force, which will consist of about 30 persons. The laboratory will rank among the best equipped wood-testing laboratories of the world, will give the Service great advantage in dealing with all problems connected with the utilization of forest products, and will form an important experimental center for all wood-using industries. The building should be ready for occupancy by January 1, 1910.

When the laboratory is equipped and ready for work, the wood-pulp laboratory at Washington and the timber-testing laboratories at Yale and Purdue universities will be closed. The centering of all experimental work in one laboratory will make both for economy and efficiency. Among the fundamental problems to be taken up will be—

In wood preservation: The determination of the fractions in coal-tar creosote which are most effective in preventing attacks of fungi and marine borers; the testing of water-gas tar, crude oil, and wood creosote for their preservative value; the testing of aluminum compounds and other cheap salts to determine whether they are effective preservatives; and the finding of a cheap, effective medium for heating timber preceding treatment.

In wood distillation: The continuation of tests to purify and standardize wood spirits of turpentine; the study of the properties and possible uses of other products of softwood distillation, such as wood creosote, pine oil, and pyroligneous acid; and the finding of methods of recovering rosin in the steam distillation of softwoods.

In tests of woods for pulp: The finding of methods of utilizing mill waste in pulp manufacture and the testing of unused woods for their pulp value.

In wood technology: The study of the relation of the structure of woods to their physical properties and to their behavior during commercial processes, such as preservative treatment; the effect on structure of commercial processes, such as kiln-drying and preservative treatment; the effect on physical properties of various methods of drying; and the relation of structure to heat conductivity.

In timber testing: The effect on the strength of timber of commercial processes, such as kiln-drying and preservative treatment; the relation between physical properties and the silvical conditions under which the tree grows; and the continuation of tests to determine the fitness of various woods for specified uses.

The laboratory will also direct field experiments and demonstrations to apply under commercial conditions the results obtained. Such work in all cases will be cooperative. In a larger degree than in the past cooperation will be with associations rather than with individuals, since this will lead to more rapid and general acceptance and application of results.

No other laboratories will be maintained by the Service except the timber-testing stations in cooperation with the Universities of Colorado, California, and Washington. These will work on problems directly concerned with the utilization of products of the National Forests, and their work and methods will be closely correlated with the central laboratory.

The studies of wood utilization will be conducted from Chicago. The work of obtaining records of wholesale lumber prices will be continued, and the gathering of prices at the mills, for which plans have been completed, will be initiated. Studies of lumber markets and of the requirements and practices of wood-using industries will be continued. The compiling for publication of the data which the Service has collected on the uses of American woods, together with the conditions which lie back of these uses, will be prosecuted steadily. When completed, the work will make available for the first time a comprehensive statement on the uses of American woods.

REPORT OF THE CHEMIST.

U. S. Department of Agriculture,
Bureau of Chemistry,
Washington, D. C., September 1, 1909.

Sir: I have the honor to transmit herewith the annual report of the Bureau of Chemistry for the year ending June 30, 1909, together with plans of the work proposed for the year ending June 30, 1910.

Respectfully,

H. W. Wiley,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

SPECIAL INVESTIGATIONS.

DENATURED ALCOHOL INVESTIGATIONS.

A special appropriation was made by Congress in the spring of 1908 for the purpose of demonstrating the manufacture of denatured alcohol on a scale applicable to the needs of the farmer or associations of farmers. To this end a small experimental distillery, with a capacity of about 100 gallons of proof spirits per day, was erected and equipped to utilize various kinds of raw materials. When this plant was ready for operation, a course of instruction in the form of lectures and actual practical operation of the distillery was given, and a number of students from the various agricultural experiment stations of the country, as well as others interested in the subject, attended. This course extended over six or eight weeks, during which time about 40 lectures were given dealing with the machinery to be used in a distillery, raw materials available for the production of alcohol, and the principles and practices of yeast making and fermentation, as well as of distillation. Experimental mashes were made using corn, potatoes, molasses, watermelons, apples (usually of unmerchantable or inferior grades), and other waste materials. The lectures and general instructions have been collected in the form of a bulletin, which covers the whole subject of fermentation and distillation as applied to the manufacture of denatured alcohol.

EFFECT OF ENVIRONMENT ON CHEMICAL COMPOSITION.

SWEET INDIAN CORN.

Following the general principles established in the study of the storage of sugar in the sugar beet and in sorghum with which these investigations of the Bureau began, the work was continued during the past year particularly with sweet Indian corn, barley, and wheat, in collaboration with the Bureau of Plant Industry and with the assistance of the experiment stations in Florida, South Carolina, Maryland, New Jersey, Connecticut, and Maine. This has been the fifth year of the systematic study of the conditions affecting the sugar content of corn at the time when it is used for edible purposes—that is, when the starch is in the dense milky state just previous to hardening. The results of the first four years of this investigation have been collated and digested, being now in course of publication.

The following general conclusions have been drawn from the work:

(1) The content of sugar in sweet Indian corn does not depend so much on temperature and length of day as is the case with the sugar beet. In the latter case the content of sugar varies inversely with the temperature, provided the latter is such as to permit normal growth, while in the case of sweet Indian corn a higher average sugar content is found in South Carolina and Florida than in Connecticut and Maine.

(2) The content of sugar in sweet Indian corn rapidly diminishes after the ear is separated from the stalk. The speed of the diminution depends largely on the temperature, being more rapid with a higher and slower with a lower temperature. Sweet Indian corn intended for the table, therefore, should be harvested as short a time as possible before being delivered for consumption, and during the intermediate period should be kept at as low a temperature as can be secured without freezing.

(3) The chief difference between the Indian corn of the extreme North and that of the extreme South is found not so much in its content of sugar as in its succulence, the lower temperatures of the North making the corn more tender and edible for a longer period than the extremely high temperatures of the South. Although the southern-grown corn had a high sugar content, it was inferior in yield and general physical appearance, but its superiority in point of sweetness opens up a possibility of acclimating the most favorable varieties and by selection and careful cultivation greatly improving the southern-grown product.

(4) Of all the factors of the environment which affect the edible quality of green Indian corn, it appears that the amount and distribution of rainfall are the most important. A moderate and well-distributed rainfall, especially during the growing season, is necessary to produce a crop having the best qualities. Excessive rainfall in the latter part of the growing season or a great deficiency during the germinating and growing period equally interferes with the quality of the crop.

VEGETABLE-PHYSIOLOGICAL INVESTIGATIONS.

The section of Vegetable Physiological Chemistry, in collaboration with various offices of the Bureau of Plant Industry, has made the following studies of the chemistry of plants and their products as affected by environment, etc.:

(*a*) The influence of environment on the composition of the various cereals, with a view to the improvement of the quality and quantity of the crop and to the adaptation of any particular variety to any locality. This study includes the analyses of grains grown in various parts of the country, and experiments to show what influence climatic conditions exert on their physical and chemical properties. Some of these experiments, which have been called "triangular experiments," are being carried on as follows:

A common wheat, Crimean, is being grown in Texas, Kansas, and California from the same original seed obtained in Kansas. At each point the seed has been grown continuously. On adjoining plots was sown seed from each of the two other stations. There were thus three plots of the same variety grown at each point. The crops were examined chemically and physically, the results showing that all three plots in any one locality give seed which are identical in appearance and in composition, as is shown by the following table:

Physical and chemical analysis of the seed of Crimean wheat sown in Texas, 1907.

Source of seed.	Protein.	Weight per 1,000 grains.	Weight per bushel.	Starchy grains.
	Per cent.	*Grams.*	*Pounds.*	*Per cent.*
Texas seed, 1906	12.1	30.8	58.9	....
California seed, 1906	10.4	34.0	59.4	64
Kansas seed, 1906	19.2	22.7	58.8	....

The crops grown in Texas from the above seed showed the following composition:

Physical and chemical analysis of crops of Crimean wheat grown in Texas, 1907, from seeds from various sources.

Source of seed.	Protein.	Weight per 1,000 grains.	Weight per bushel.	Starchy grains.
	Per cent.	*Grams.*	*Pounds.*	*Per cent.*
Texas seed, 1906	18.2	23.6	58.6	5
California seed, 1906	18.2	22.7	57.3	....
Kansas seed, 1906	17.0	23.6	58.6	2

In the same way the crop grown in California was identical in all three plots although the composition of seed sown varied greatly.

Physical and chemical analysis of seed of Crimean wheat grown in California, 1907, from seeds from various sources.

Source of seed.	Protein.	Weight per 1,000 grains.	Weight per bushel.	Starchy grains.
	Per cent.	*Grams.*	*Pounds.*	*Per cent.*
California seed, 1906	11.3	33.3	61.8	40
Kansas seed, 1906	11.0	33.8	61.3	50
Texas seed, 1906	11.4	33.0	61.3	50

The same facts were observed in all three plots grown in Kansas in 1907, and at each apex of the triangle in 1908, and also with another variety of wheat (durum) which has been grown in Kansas, California, and South Dakota.

The experiments have shown that the same variety of wheat will give the same crop, physically and chemically, when grown in any one locality, even though the seed used may have had a very different composition and appearance and may have been grown under widely different conditions. Thus, a California Crimean containing 11 per cent of protein and a Kansas Crimean of 20 per cent of protein give crops identical in composition when grown in the same environment. Thus, the Kansas Crimean with 20 per cent of protein fell in one year to 11 per cent of protein when grown in California; that is, it yielded a crop identical with that produced by the California Crimean in California. On the other hand, the California seed with 11 per cent of protein and the Kansas seed with 20 per cent, when grown in Kansas the following year, both contained over 18 per cent of protein. These results show that crops must be improved by selection, etc., in the very locality in which they are to be grown, there being apparently no advantage in importing an improved seed into another locality of widely different climatic conditions.

(*b*) Soil-climate experiments carried on in collaboration with the physicist, bacteriologist, and cerealist of the Bureau of Plant Industry to supplement the "triangular experiments." To show what rôle the soil might have played, 75 cubic feet of earth were exchanged by California, Kansas, and Maryland, and four plots at each place prepared with the four different soils. These were sown with the same kind of wheat, the first crop being harvested this year, and its analysis will furnish further data as to the rôles played by the soil and climate.

(*c*) The composition of the different cereals at various stages of growth in order to understand how plants absorb plant food; at what stages they require and absorb the various elements and to what extent; whether they retain the plant food absorbed to their maturity, and in what proportion these plant foods are removable through rain or other climatic agencies. A study of the organic constituents of the plants at different stages of growth shows that young barley plants contain over 20 per cent of soluble carbohydrates (mostly sugars), and this fact tends to explain why it is that when such young barley plants are plowed under they serve so beneficially in aiding the bacterial activity in soils. The study of the other organic constituents—for example, pentosans, fiber, starch, etc.—at different periods of growth is also being carried on.

(*d*) The results of the study of the amount of salts present in cereal crops at different stages of growth and of the amount removed by leaching show that a very large amount of phosphorus, calcium, magnesium, potassium, and sodium is removed by rainfall, especially from the dying and wilted leaves, the amount removed from green or young plants being relatively small. The results of this study show that on ripening the salts contained in the juices of plants tend to migrate from the dying to the living tissue, that the migration is upward; that plants exude their salts upon the surface of the leaves, and that rain water may wash these salts back into the soil, and that therefore the analysis of plants for ash ingredients may give erroneous results, especially if it be desired to arrive at the amount of plant food absorbed by or essential to plant growth, unless the amount of these ingredients removed from the plants by rain, dew, etc., be taken into consideration.

(*e*) The chemical and physical changes of grains on storage, and the chemical changes of the ground seeds when kept for several years. This study has shown that the ground grain changes more rapidly in composition than the unground, and of all the cereals under investigation the changes in the composition of corn were most marked, the amount of sugar falling off very rapidly on storage.

(*f*) The relative value of American barleys for malting purposes—the malts to be used either for brewing or for the conversion of the starch of raw materials into sugar for the production of denatured alcohol—were studied, the preliminary results being published as Bulletin 124 of the Bureau.

(*g*) Greenhouse experiments with cereals to determine the influence of the amount of water applied to the soil, before and after heading, the influence of various fertilizers on the composition of the straw and grain, the influence of the magnesium-calcium ratio and the effect of manganese, etc., on the growth. Although the lack of a suitable greenhouse has handicapped the work, the results show that the addition of much water to the soil tends to the production of those white spots so often seen, especially on durum wheats, thus corroborating observations in the field, which show that during a cold, rainy season the proportion of soft or starchy kernels is far greater than during a hot, dry period, and that in consequence the protein content is correspondingly lowered.

(*h*) Collaborative experiments with various experiment stations at Reno, at Logan, and at Fort Collins on the influence of different amounts of irrigating waters applied to the growing crop on the composition of the grain; at Knoxville on the influence of various phosphate fertilizers on the constituents of the wheat; at Maryland, Kansas, and California on the influence of the exchange of soils on crop growth and composition.

(*i*) The proper amount of acidity which peat should possess in order to grow blueberries, in collaboration with the botanist of the Bureau of Plant Industry. One of the questions solved was the determination of the amount of acid in peat best suited for blueberry culture and a method was found for correcting the condition of peat in which the plants will not thrive.

(*j*) The amount of alkaline salts removed from alkaline lands by leaching. This work was done under the direction of the Office of Western Agricultural Extension of the Bureau of Plant Industry.

(*k*) The changes taking place in the mineral constituents and in the nitrogen of the seed of wheat and other grains during germination and during the very early stages of growth.

(*l*) The absorption of plant food by plants grown in the Great Plains area, a work carried on in collaboration with the Office of Dry Land Agriculture and the physicist of the Bureau of Plant Industry.

(*m*) The kind of sugar present in wheat and the various ways for improving our methods of analyses.

In order to carry on all this work it has been necessary to make over 10,000 determinations of all kinds.

ANIMAL-PHYSIOLOGICAL CHEMISTRY.

Investigations in animal-physiological chemistry have been conducted along the following lines:

A series of metabolism studies conducted by feeding organic and inorganic phosphorus to rabbits was completed and the results published as Bulletin 123. This line of work was further pursued by a similar investigation on feeding animals with different forms of sulphur to determine the variations and form of the urinary sulphur compounds eliminated. Another series of experiments in feeding animals with different kinds of carbohydrates to determine their comparative food value was begun.

An important part of the work of this laboratory has been the enzym studies, in which several papers have been published, dealing with the laws and action of enzyms, and the preparation, in large amounts, of different enzyms in concentrated form. The special application of this research is the relation of enzym reactions to ordinary and special analytical methods, and already much valuable progress has been made. This work will be prosecuted vigorously during the coming year.

Work on methods for the examination of meat has been conducted especially with a view to measuring the progress of deterioration by accurately determining the increase in ammonia, previous work having shown that the deterioration of meat was evidenced chemically largely by an increase in this product.

Four hundred samples were examined, from three to five determinations being made, as a rule, on each sample.

ENOLOGICAL-CHEMICAL RESEARCH.

Work in enological-chemical research has been continued on the lines previously followed and the enlargement and better equipment of the laboratory and cellars have made it possible to extend the investigations in several directions, notably to undertake an important series of experimental studies of yeast races, using for this purpose both races isolated from American products and those secured from foreign laboratories. This study is designed:

(*a*) To determine the fermenting power of these yeast organisms in natural fruit juices, and in the same juices when fortified with gradually increasing percentages of cane sugar. The points determined are: (1) Ability to ferment promptly the natural fruit sugar; (2) to invert and ferment added cane sugar; (3) the degree of alcohol obtained for sugar decomposed; and (4) the acid content of the fermented product, especially volatile acids. Other subsidiary data are also determined.

(*b*) To determine the ability of these yeast organisms to ferment fruit juices in the presence of varying amounts of preservatives, as (1) sulphur in various forms; (2) sodium benzoate; (3) salicylic acid, etc.

(*c*) To determine the maximum temperature limit at which these yeast races can carry to completion a sound fermentation.

Final results along these lines can not be obtained for several years, but important data have been secured under section (*a*) which are now available for practical work in the factories. These studies have required during the fiscal year the incubation of 228 separate cultures, and more than 3,400 chemical determinations have been made.

The distribution of yeast cultures has been continued as in previous years. The aim has been not to exploit or urge the use of yeasts, but to furnish reliable cultures on request for the purpose of testing their use in practical work. Instructions for the use and propagation of the cultures are furnished, so that those receiving them are able to extend their use as they see fit. In the past year cultures have been sent to 25 States, and the reports made are in many instances very favorable. The results of this work will be summarized, so that all interested may benefit by the experimental data obtained.

The work of collecting and studying native American wines has progressed as rapidly as the pressure of other work would permit. One hundred and ten samples of such wines have now been subjected to chemical analysis and to organoleptic tests.

In all, 622 samples have been examined chemically, and in some cases microscopically, during the fiscal year, from 2 to 15 determinations being made in each case.

BACTERIO-CHEMICAL EXAMINATIONS.

The bacterio-chemical investigations pertain largely to the enforcement of the Food and Drugs Act. The samples examined may be classified under inspection or interstate samples and research work:

Interstate samples.

Ketchup	28	
Cream	11	
Ice cream	30	
Milk	18	
Water, bottled (each containing from 1 to 12 bottles per sample)	51	
Miscellaneous	37	
Total samples		175

Research work.

Antiseptics, disinfectants, preservatives	22	
Ketchups	16	
Cream and ice cream	11	
Eggs and egg products	63	
Codfish	10	
Gelatin	26	
Milk	26	
Oysters, clams, and quahogs—liquors and washings	133	
Water:		
Bottled, market	68	
City hydrant	44	
Sea	69	
Well and spring	46	
Miscellaneous, including ice	16	
Miscellaneous	102	
Total research		652
Sum total		827

The miscellaneous research samples examined consisted of bread, butter. condensed milk, starches, canned salmon, cream puffs, lactobacilline preparations, fruit juices, canned fruits, soft drinks, water cress, yeast cakes, zymin, and paper used for wrapping hams.

The most extensive investigations conducted during this year were those relating to the shellfish industry. The most important problems considered were: (1) The possibility of shellfish pollution from sewage-polluted waters, including a study of the effects produced by floating, drinking, plumping, etc.; (2) sanitary conditions of the establishments and of the practices pertaining to the shucking, handling, and shipping of shellfish. This work was done in cooperation with the Division of Foods and in connection with the Water Laboratory of the Miscellaneous Division.

The need for bacteriological investigation becomes greater as sanitary ideals in the preparation and handling of food materials advance, and it is the policy of this laboratory to extend its researches to the most urgent cases as rapidly as efficiency will permit.

IMPORTANT FOOD INVESTIGATIONS.

SPECIAL RESEARCH WORK OF THE DIVISION OF FOODS.

OYSTERS.

The investigation of shellfish begun by the Division of Foods during the last fiscal year has been continued. This has included the examination of the waters from which shellfish intended for interstate commerce are taken and the investigation of the plants in which they are packed, the methods of handling, and the materials used. In collaboration with the Oyster Packers and Growers' Association a number of experimental shipments were made on a commercial scale, oysters being taken from several localities of the United States and shipped by the various methods in ordinary practice. The shipments were made under seal to the inspection laboratories in Omaha or Chicago, where the packages were opened and re-iced, again sealed, and shipped to the Bureau of Chemistry in Washington, where final examination was made.

The results of the investigations warrant the conclusion that washing should be limited to the shortest practicable time, and that the oysters should be shipped in closed packages protected from direct contact with ice. The study has also been extended to clams and scallops, of which, however, no commercial shipments were made.

FRUIT.

Experimental work relative to fruit products in collaboration with the pomologist in charge of field investigations of the Bureau of Plant Industry has been continued. The fruits used in the investigations were grapes, apples, Japanese persimmons, avocados, peaches, plums, strawberries, raspberries, currants, blackberries, huckleberries, pineapples, oranges, and lemons.

As a result of the prohibition laws enacted in some of the Southern States, the Department was requested to suggest a means of utilizing the southern grapes of the Scuppernong type which had formerly been used in the preparation of wine. In order to compare the juice prepared from this variety of grapes with that of the ordinary Northern American varieties, the juices of the Scuppernong, Concord, and Catawba grapes were employed. The preservation in clear form of the Scuppernong juice offered no greater difficulties than did that of the juice of the other varieties mentioned. Some difficulty, however, was encountered in separating the juice of this grape completely from the pulp without the application of heat, and this process is undesirable, as a cooked taste is usually developed when grapes are heated before pressing. It therefore appears that further study must be given to the technics of heating and pressing, clarifying, and sterilizing on a commercial scale.

The work on apple juices previously reported has been extended. Sterilized juices were prepared from 15 varieties of apples, and a study of these juices was made with respect to their composition, flavor, and other qualities, and especially the permanence of their flavor when properly preserved.

The study of Japanese persimmons has been continued and considerable progress has been made in the development on a commercial scale of the alcohol method of treating persimmons, rendering them nonastringent and edible while still firm. The results have been successful and the study will probably be completed during the next fiscal year. The preparation of persimmon vinegar and of dried persimmons has also been studied.

The juices of strawberries, red and black raspberries, currants, huckleberries, blackberries of several varieties, oranges, lemons, and pineapples have been prepared and preserved by sterilization and their composition studied. The analysis of these products includes the study of the naturally occurring organic acids. The investigation of the pineapples includes the production of a dried and sugared preparation.

TOMATO KETCHUP.

A large number of typical samples of tomato ketchup were submitted to examination for the purpose of establishing methods by which their character and quality might be determined, with the result that methods were elaborated by which it is possible to distinguish with a considerable degree of certainty ketchups made from waste material and trimming stock and those made from whole tomatoes.

THE INFLUENCE OF TIN RECEPTACLES ON THE CHARACTER AND COMPOSITION OF FOODS.

A systematic study has been undertaken during the past year of the character of material used in the manufacture of food receptacles and of the influence of these receptacles on the character and composition of the foods preserved in them. The investigation also includes the study of the effect of the temperature and method of treating, time of storing, and, as far as possible, all other conditions entering into the question. Samples of tin plate of various kinds have been carefully examined, the various grades of cans employed in the United States receiving special attention as preliminary to the investigation. Samples of various types of food canned at different times, with as full data as possible regarding the methods of their preparation, have been secured and examined. Samples have also been prepared in the presence of representatives of the Department, with a view to examining from time to time products regarding which full information is available. The results thus far obtained are only of a preliminary nature.

ANALYTICAL METHODS.

Material progress has been made in the improvement of methods for the detection of food adulteration, distilled liquors, flavoring extracts, and preservatives having received special attention.

As in the past, analyses have been made of samples of foods submitted by the Commissary-General of the Army and the Paymaster-General of the Navy for the purpose of assisting in the purchase of supplies, and the Bureau has also been called on to collaborate in prescribing specifications for such purchases.

FOOD TECHNOLOGY.

The work of the Food Technology Laboratory is divided into three sections: First, that pertaining to the enforcement of the Food and Drugs Act; second, research work on methods for the analysis of flavoring extracts and essential oils; and, third, the investigation of the question of producing citrus fruit by-products in California. Until April 15, 1909, all food cases for presentation to the Board of Food and Drug Inspection were passed on by this office. After this date, however, the system of handling these cases was somewhat changed, and the work of the laboratory in regard to the administration of the Food and Drugs Act was confined to preparation of cases concerning essential oils and flavoring extracts, 63 analyses having been made of such samples. All of the routine work which had formerly been done in the Washington Food Inspection Laboratory on this subject was transferred to this laboratory, and the initial analyses from the Washington district, as well as check analyses from other districts, were made here.

The research work has been confined to methods for the detection of adulteration in flavoring extracts. After finishing the examination of the authentic samples from Sicily, the assistant in charge of the essential oil analyses spent considerable time in developing a method for the detection of added lemon terpenes to lemon oil. This work was finished January 1, and 25 samples of lemon oil were examined in this regard to test their legality under the Food and Drugs Act. The method developed for the detection of lemon terpenes, it is believed, is satisfactory, and special apparatus is now under construction for installation in the food and drug laboratory at New York to facilitate the examination of imported oils for this adulteration.

Other investigations on flavoring extracts include the solubility of lemon oil in ethyl alcohol at varying temperatures and dilutions, the effect of storage on lemon extracts and terpeneless extracts of lemon, and a practical method for manufacturers for the estimation of citral in lemon extracts. Some little work has also been done on the detection of artificial coloring matter and of prune juice in vanilla extracts.

This laboratory has also undertaken an investigation of the possibility of profitably producing citrate of lime, oil of lemon, oil of orange, and other orange by-products in California.

CANNING INVESTIGATIONS.

The following investigations, which are especially opportune and of great practical value at this time, were conducted for the purpose of promoting the preservation of foods by sterilization:

Canning peas, corn, and tomatoes.—Experimental work is being continued on the canning of peas, corn, and tomatoes to determine the effect of different methods of handling and processing on spoilage and on the quality of the finished product. The methods which will prevent swells, sours, etc., are well understood by canners in general, so that the losses from this source are becoming less and less each year. The general limits recommended for time and temperature are usually high and give a margin for any contingency. The canners are not so familiar, however, with the effect of handling and processing on the quality of the goods. It is believed that a large part of the goods on the market are not of so high a grade as they might be if the effects of each step were better known. Some of the results of grading and processing of peas have been pointed out, and from the interest manifested by the canners it is evident that improvements will be attempted at many factories.

Grading of canned goods.—A line of cooperative work is being conducted to determine what should be the reasonable requirements for the different grades of canned goods. It is generally recognized that the consumer does not know what he will receive in making a purchase of a can of goods. The grading of the different manufactures on quality is not uniform, and therefore the brand is more important than the grade claimed. The determination of what may reasonably be expected from a can of any grade will evidently be to the advantage of the better class of packers and to the consumer.

Shrimp.—Experiments were made in canning shrimp in the style generally known to the trade as “headless.” Shrimp are canned with all the shell removed, and it has been claimed that they could not be canned with the shell on. The object in following the latter procedure is that it saves labor and expense at the time of canning, gives a more attractive appearance to the finished product, and conserves a delicate flavor which is lost in the ordinary method. In preliminary experiments some lots of the headless shrimp have been put up successfully, but the work has not yet been duplicated, as there was no spring catch of shrimp this season.

RESEARCH WORK ON THE DETERIORATION OF FOODS.

On July 1, 1908, the Food Research Laboratory was formally established for the special purpose of studying the causes and progress of the deterioration of foods on keeping. The work, as heretofore, has dealt chiefly with the changes undergone by flesh floods, including milk and eggs, during storage, but has been extended to include changes at ordinary temperatures as well as at the refrigerator temperatures used commercially.

Seventeen analyses were made of samples consisting of from 9 to 18 individual eggs. Plymouth Rock eggs and Leghorn eggs were analyzed separately, and also fall eggs and spring eggs. A bacteriological study of the number and kinds of organisms present in the yolk and the white of the egg was made, as well as a chemical analysis of each, the examination including the fat constants, water, ash, total nitrogen, and the distribution of the nitrogen in the various protein combinations in the white of the egg.

ANALYTICAL AND BACTERIOLOGICAL EXAMINATIONS.

For the laboratory examinations it has been necessary to revise and adopt methods, both bacteriological and chemical, for the investigation of the condition of the fowls as compared with normal, perfectly fresh birds. The extent of the analytical work is better indicated by the number of determinations and their distributions, the number of samples giving no adequate idea of the amount of work done.

Quantitative determinations of fat (butter, egg, and chicken)	378
Determination of constants on 144 fat samples (iodin, saponification, Hehner, Reichert-Meissl numbers, acid value, and index of refraction)	1,008
Determinations of ash	199
Determinations of total solids	420
Determinations of nitrogen	2,365
Miscellaneous determinations (phosphoric acid, sulphur, sucrose, indol, etc.)	124
Total	4,494

The naturally occurring mixtures of protein in milk, eggs, and flesh have been analyzed for soluble and insoluble nitrogen, coagulable and noncoagulable, albumoses, and nitrogenous extractives, as follows: Milk protein, 18 samples; chicken protein, 74 samples; and egg protein, 24; a total of 116.

The bacteriological examinations include the quantitative determination of the number of organisms, their species in many instances, their adaptability to heat conditions, etc. The question of temperature has, of necessity, been carefully considered, and many sets of cultures have been made and grown varying from blood heat to below 0° C. In the study of chicken flesh, light and dark meat were examined separately and evidences of the coli group especially sought. Yolks and whites of eggs have also been separately studied and a large number of organisms isolated from this source.

HANDLING OF POULTRY.

The study of cold-stored market chickens, begun several years ago, indicated that it must be supplemented by an investigation of chickens of known history in order that the results might be compared and properly interpreted. Such studies have been made and are now being prepared for publication. They include chemical, bacteriological, and histological data and are compiled from the analysis of a large number of birds of different breeds and ages.

Just as the study of commercial chickens led to the study of those of known history, so the work on the latter has pointed to the need for an investigation of the handling of poultry previous to storage in relation to the effect of its keeping qualities, and, therefore, its fitness for food. During the past year such an investigation has been planned and is now under way. Packing houses, transportation agents, warehousemen, commission merchants, retailers of poultry, in fact, all branches of the industry, have been visited and the cordial cooperation and assistance of each have been extended to the Department in its efforts to insure better poultry in the markets.

It is planned to make as complete a study as possible of all the conditions to which a chicken may be subjected from the time it is killed until it reaches the consumer. To this end an accurate record is kept of every step in the packing house—killing, bleeding, picking, cooling, packing, and shipping. The details of transportation are obtained with equal thoroughness and the condition of the poultry when it reaches its first destination is carefully noted, both by ordinary inspection and also by laboratory examination, bacteriologically and chemically. Should the goods be consigned to a cold-storage warehouse, and reshipped from it to a near-by or distant point, they are again inspected on their arrival at either a second warehouse or the commission merchant's. Should a shipment go into commerce immediately, it is kept under observation until it does get on the market. In this way there will be a complete record of the conditions which may affect the final result, as well as the result itself, thus enabling one to correlate cause and effect with accuracy.

Such a study made in many and varied warehouses in different parts of the United States, with long and short hauls, where the goods are intended for immediate use and where the consumption is delayed for months and cold storage is used as a preservative, is not only of value as an addition to our scientific knowledge of the decomposition of flesh as influenced by various commercial methods, but should also prove most valuable to the consumer, since it makes for better food, and to the poultry industry, which is very desirous of improved methods and better final products.

EXAMINATION OF DAIRY PRODUCTS.

The Dairy Laboratory makes examinations of dairy products of all kinds and studies methods of analyzing them. It also examines all samples of the various kinds of dairy products taken in the enforcement of the Food and Drugs Act.

During the past year a large number of importations of foreign cheeses, including many varieties, has been examined, with the result that a considerable amount of fraud has been detected and suppressed, the greater part consisting in the offering of skimmed-milk products under the guise of whole-milk or full-cream cheese. In many cases the relabeling of the goods to conform with the facts has been required, and in a few instances where the goods were in very bad condition they have been denied entry as being unfit for human food. The advent into commerce of fancy tinned cheeses, purporting to be preserved by heat, introduces a new risk to the consumer, since a handsomely labeled tin box may, on opening, prove to contain a cheese not well sterilized and sometimes in a condition unfit to be eaten.

Of the dairy products in interstate commerce, those to which most attention has been given are fresh market milks, condensed and evaporated milks, and cheeses. Fresh milks marketed in Chicago, St. Louis, Kansas City, and Cincinnati, from the adjoining States, were examined by the Dairy Laboratory in collaboration with the inspection laboratories in the cities named, with the result that the adulteration of milk for city consumption proved to be more prevalent than had been thought. The milk of Chicago, as a whole, was much better than that of the other cities named, that of St. Louis was next best, and that of Cincinnati was the worst. Here watering was surprisingly in evidence, the claim being made that ice was put into the milk cans to cool the milk. While the use of ice for cooling milk, if applied in the right way, is most commendable, the addition of it to the milk itself is not to be tolerated. It is intended to follow up this work at intervals in the future.

The examination of interstate samples of domestic cheese has shown that while, as a rule, goods of this class are honest and honestly labeled, there are still some manufacturers who attempt to sell skimmed-milk cheeses under the guise of the whole-milk product. Even adulteration by the addition of a foreign substance is sometimes, though rarely, practiced; in one instance, an entire case of so-called "Neufchatel" cheese was found to contain upward of 20 per cent of corn starch.

The subject of evaporated milk has demanded a large share of attention during the past year, for the reason that many of the manufacturers have claimed that the standard for total solids, namely, 28 per cent, is unreasonably high, alleging that it is impossible to attain this standard at all seasons of the year, fall and winter especially, and still produce a smooth, homogeneous, marketable product. To investigate this claim and to gather data for an opinion as to the justness of the existing standard has been one of the duties of the Dairy Laboratory, the performance of which has involved a great amount of labor. Observations of the process of manufacture have been made at several different factories and analyses have been made of more than one hundred samples of the product manufactured under varying conditions and after storage for different periods of time. More observations of a similar nature are to be made during the coming autumn and winter, and no pains will be spared to obtain all necessary data for reaching a just decision in the matter.

A classified list of samples examined is as follows:

	Number of samples.
Fresh milks	421
Cheeses	404
Evaporated milks	177
Condensed milks (sweetened)	53
Butters	47
Creams	13
Miscellaneous (ice creams, oleos, etc.)	25
Total	1,140

Of these, 239 were received from the food-inspection laboratories, 711 were inspectors' samples, and 126 concerned the investigation of evaporated milk.

SUGAR-PRODUCING PLANTS AND THEIR PRODUCTS.

The Sugar Laboratory has made a special investigation of the maple sugar and sirup industry of the United States, collecting about 720 samples of pure products of known origin, over half of which have been analyzed. The results will be of value in more clearly defining the character and limits of composition of the pure product from various sections, thus enabling one better to determine the many forms of adulteration practiced. The manufacturing data collected in each case when considered in connection with the analytical results will point to the best methods to be followed. The analysis of the remaining samples will be finished and some additional field work done during the coming maple season, which will complete the present investigation. In carrying out this study the laboratory has had the help of the official inspectors and of the chemists from several of the food-inspection laboratories.

During the first part of the year the quality of honeys imported into the United States was studied. About 100 samples were collected and a complete analysis was made in each case. The results will show the general composition of this class of honey, and in connection with the investigation methods of detecting adulteration have also been studied.

Investigations are being made looking to the improvement of the methods of analysis of beet, cane, and sugar-house products. This work will be of value to the farmers producing these sugar-bearing plants, as they are quite often sold to the factories by analysis, and also to the sugar factories in determining the per cent of sugar in all classes of samples. The analyses of all beet samples coming from the experimental work of the Bureau of Plant Industry are made in this laboratory.

The general methods of sugar analysis are constantly being studied and experiments conducted to improve their efficiency and to establish new methods. Some work has been done on the effect of temperature on polarization of sugar products, also on the use of the refractometer in the estimation of dry substance.

A total of 1,125 samples has been analyzed during the past year, which may be classified as follows to show the field covered:

	Samples.
1. Beets, sorghum, and sugar cane	345
2. Official food samples (maple and cane sirups, molasses, and honeys)	31
3. Imported honeys	73
4. Sugar-factory products (bagasse, molasses, and cane sugar)	64
5. Maple sirup and sugar	385
6. Samples for other laboratories and Departments:	
Dextrin, starches, and glucose (Bureau of Engraving and Printing)	29
Mannose solutions (Animal-physiological laboratory)	60
Raw material, mashes, and beers for denatured alcohol plant	60
7. Miscellaneous sirups and samples	55
8. Starch products	23
Total	1,125

DRUG WORK.

INVESTIGATION OF DRUGS ON THE MARKET.

The investigations conducted by the Division of Drugs are chiefly concerned with the composition, adulteration, and misbranding of drugs and chemicals as found on the American market and shipped in interstate commerce in violation of the Food and Drugs Act. The chemical reagents used by the Bureau of Chemistry in its general analytical work are also examined. These lines of work require a study of the methods of analysis, of the standards at present official for certain products, and of normal products, with a view to establishing standards and supplying the necessary data on which to base action. The study of the keeping qualities of hydrogen peroxid and of the deterioration of certain plant products and preparations derived from the same was also continued.

Much work has been done with the view to establishing quantitative and qualitative methods for estimating the several constituents present in drug mixtures such as the drug-addiction treatments, so-called cancer cures, consumption cures, asthma cures, etc., and other preparations containing habit-forming drugs, such as morphin, cocain, acetanilid, antipyrin, chloral hydrate, opium, heroin, diacetyl-morphin, the eucains, etc. During the fiscal year ending June 30, 1909, there were examined in this division 2,080 samples. Of this number 601 were chemical reagents, 1,220 imported drugs, and 860 domestic articles. These samples include all materials, whether collected under the Food and Drugs Act, for information, or to be used as a basis for establishing data on which to fix standards, or examined for the various other Departments.

The quality of drugs imported has materially improved. When the work was first begun it was rarely found that an importation of belladonna root was not adulterated with some foreign root, such as pokeroot, scopola root, etc., and the same was true of the leaves. At present it is rare to find this drug so adulterated. Attention should be called to the fact that some importers are persistently offering assafœtida of a low grade, claiming that the better article can not be secured abroad, but this has been conclusively shown to be erroneous, as some assafœtida of the character prescribed by the Pharmacopœia is received. A considerable number of samples of powdered assafœtida examined show that this commodity is highly adulterated. This article, furthermore, is of questionable value as a medicinal agent, inasmuch as a large proportion of the active medicinal agents are volatilized in the course of drying the original material for powdering purposes. The agents commonly employed as diluents are magnesia, starch, etc. It has also been found that the soluble material present in some of the powdered products is not derived from assafœtida proper. Henbane leaves also still show adulteration, and it is maintained by some importers that this commodity can not be purchased of the alkaloidal strength prescribed by the Pharmacopœia. The examinations made at the ports, however, show that the material offered since January 1, 1909, has been up to the standard in this respect; and, furthermore, the physical appearance of this drug has materially improved during the past few months, showing that the new crop has been collected with more care and discrimination.

The examination of the samples collected in interstate commerce develops some interesting facts. Colocynth, for example, is one of the drugs most commonly adulterated. The Pharmacopœia specifically states that the seeds shall be removed before the article is used in the preparation of medicinal agents, but some of the colocynth at present on the market is either a mixture of pulp and seeds or consists largely of the seeds themselves. The latter practice is most censurable. A sample of kamala was found to consist of nothing but red sand. Powdered conium and ipecac have been found adulterated with powdered olive stones, gentian mixed with ground peanut shells, and *Hyoscyamus muticus* substituted for henbane leaves, the label being Hyoscyamus, U. S. P.

CHEMICAL REAGENTS.

The chemicals examined were those regularly supplied to the Bureau of Chemistry on contract and requisition, to be used in the analytical work of the Bureau. All chemical reagents are examined in the Drug Division and supplies sent to the branch laboratories from the general supply office in Washington.

It is of interest to note that during the past year the quality of these reagents has markedly improved as compared with those examined during previous years, especially at the time when a systematic investigation of chemical reagents was first instituted, in 1903. Chemicals of inferior character, contaminated with insoluble matter and impurities so as to render them unsuitable for chemical analysis, are not now as often found. To illustrate the willingness of chemical manufacturers to cooperate in improving these supplies a few examples are cited:

Dealers who had the contracts for supplying ethyl acetate and carbon tetrachlorid repeatedly maintained that a product of the purity demanded by the Bureau was not available and could not be purchased. These statements were known to be incorrect, inasmuch as the Bureau had not only purchased the latter article of satisfactory quality, but had made it for its own use. One of the manufacturers then instituted a series of experiments and found that the quality desired could be supplied, since which time no difficulty has been experienced. Correspondence and interviews with manufacturers also established the fact that there was no difficulty in supplying ethyl acetate of proper quality, if the proper price was paid.

One of the chemical reagents with which considerable difficulty has been met in the past is acetic acid, 99 per cent pure, to be used in determining certain constants in fatty oils. Very little of the production on the market will comply with the rigid sulphuric-acid-bichromate test.

An investigation was also instituted to determine the quality of the various glacial phosphoric acids on the market. This was done both because this agent is used in analytical work and because it forms the basis of a number of medicinal agents. It is well known that the glacial phosphoric acid on the market is not a single substance, but a mixture of meta-phosphoric, para-phosphoric, and ortho-phosphoric acids, together with more or less sodium phosphate. The latter is added for the purpose of causing solidification of the product, thus enabling the manufacturer to supply an article of attractive physical appearance. Investigation showed that the various brands were not only contaminated with sodium phosphate, but that reversion from the lower hydrated acids to the higher hydrated products was continually taking place, the rapidity of such reversion depending on a number of factors, namely, temperature, concentration, and the nature of the associated substances.

Hydrogen peroxid is used to a considerable extent in chemical analysis, the strength of the article usually supplied being 3 per cent hydrogen peroxid, commonly called "10 volume." Most of the brands tested, while complying with the standard prescribed by the United States Pharmacopœia, which is not intended to supply a product of absolute purity, contained acetanilid, which may interfere with chemical analysis, and one sample also contained caffein.

ESSENTIAL OILS.

The Essential Oils Laboratory investigates the composition of these important constituents of drug products, as well as the methods for their identification.

Numerous complaints have been received relative to the standard of the Pharmacopœia for oil of peppermint and the inefficiency of the various tests for detecting the adulteration of oil of wintergreen with oil of birch, methyl salicylate, or mixtures of the two. In order to ascertain existing conditions it was decided to make an investigation of the producing regions and trade conditions before making any extensive chemical examination of the various products on the market. For this purpose representatives were sent into the peppermint-oil fields to secure information as to the kinds of plants used in preparing the various grades of oils, the care exercised in keeping the oil after distillation, etc. A number of authentic specimens have also been collected and submitted to analysis to determine the reliability of the dimethyl sulphid test.

Some investigations were also made in the field relative to the methods of producing oil of wintergreen and oil of birch. It soon became evident that very little genuine oil of wintergreen was produced. Data were collected as opportunity presented, and when it became known to the trade that an investigation was in progress, greater care was exercised in the handling of the natural oil of wintergreen, under which name oil of birch is commonly sold. In fact, several dealers made investigations for themselves, and when one firm published the fact that at present there was no oil of wintergreen available and that, with few exceptions, the article sold to the trade was spurious, consisting of oil of birch or mixtures of oil of birch and methyl salicylate, quite a sensation was produced. It was the belief six months ago that less than 25 pounds of oil of wintergreen were on the market. Some producers claim that the manufacture of this oil at present prices is an impossibility, the production of the genuine oil costing from $10 to $12 per pound. Before prosecuting these fraudulent transactions it was necessary to provide reliable methods for establishing the genuineness of a given sample of oil of wintergreen, none being known as far as could be determined. A considerable number of samples have been collected and the work is progressing. Many of the oil of cassia importations, as well as the domestic samples, are contaminated with undesirable metallic substances, and it is usually claimed in such cases that the oil is "for technical use only."

The percentage of alcohol present in medicinal products has been estimated in 200 samples, including products which contain, among other ingredients, essential oils. It is well known that the essential oils tend to vitiate the results obtained by the regular methods for determining alcohol. Experiments were instituted for the purpose of determining to what extent this is true and also to ascertain what methods would be most suitable for the various kinds of products. It has been found that the method of shaking out a saturated salt solution with petroleum ether and subsequently distilling the aqueous portion gave results which are closely in accordance with the facts. The refractometer and ebullioscope were also employed, but the results were not as satisfactory as desired.

COOPERATION WITH THE POST-OFFICE DEPARTMENT.

During the past year the Division of Drugs made analyses of 15 medicinal agents represented as cures for various maladies sent or prescribed through the mails in violation of the postal laws. The investigations required not only the analysis of the samples of medicines used in the treatments, but also a study of all of the claims and representations made for the treatments, that the Postmaster-General might be advised as to whether or not false and fraudulent representations and promises had been made. Generally the treatment included several agents. In most cases these remedies consisted of mixtures of ordinary medicinal agents which are useful and of service, but which can not in any sense be considered as cures for the numerous diseases for which they are advertised and sold. A single instance will illustrate this point: A so-called "cancer cure," advertised and exploited under the name "Radol," consisted of two aqueous solutions which it was claimed had been "radiotized" by radium emanations. An investigation, however, showed that they did not possess any greater radio-activity than ordinary water, if as much, and that the fluorescence present in one of the solutions, said to be due to the radium emanations, was introduced by means of quinine sulphate, the whole being acidulated with an inorganic acid. The statements made as to the constituents of the remedies proved to be equally false, and a fraud order was issued, with the result that the business was discontinued. Simultaneous with the issuing of the fraud order a criminal case was filed in the courts of St. Louis; the promoter of the remedy appeared in court, pleaded guilty to the charges, and was fined $100. There are about eight other cancer-cure treatments under investigation, besides tuberculosis cures, vitality restorers, and similar remedies, all plainly of a fraudulent character.

SO-CALLED "CANCER CURES."

The Drug Division has in its possession the entire treatment, directions, etc., of a considerable number of these "cures" and correspondence is under way in regard to many other cases. The promoters of these treatments, in order to bring them to the attention of the public, use in their advertisements, correspondence, and circulars many gross misrepresentations and promises. In fact, there is hardly any other line of business which is equal to the cancer-cure treatments in this respect. The methods of obtaining patients vary slightly in each case, but the general principles are the same, and the mixtures employed also have some similarity. Their treatment consists chiefly in using a tonic medicine, a local application, and some escharotic to destroy the cancerous tissue. It is immaterial whether the cancer is on the surface or is internal; they will represent that this malignant disease can be successfully treated by their remedies. One promoter represented at the hearing that the arsenical paste in his hands would accomplish results entirely different from those obtained by medical practitioners. Exactly how this is accomplished he was unable to explain. Another treatment consisted of a dough in which was incorporated a small amount of zinc chlorid. Experiments made upon the human body indicated that this combination has little, if any, escharotic effect. Another treatment employs a so-called "absorbent," consisting of a muslin bag inclosing a certain mixture, which constitutes the basis of the treatment and the absorbing action. Analysis fails to find the presence of any agent excepting charcoal which could be considered as absorbing any substance emitting from an open wound or cancerous growth. The method of diagnosing the affliction of the patient in absentia by symptom blanks is virtually worthless. It is well known to medical practitioners that an absolute diagnosis of cancer can only be made by the use of a microscope in the hands of a competent pathologist.

PRESCRIPTION SCHEME REMEDIES.

Since the passage of the Food and Drugs Act there has been placed upon the market a line of preparations, the advertisements of which embody a prescription, which contains several well-known agents, together with a coined name of some unknown product. In order to fill this so-called " prescription " it is necessary to purchase the agent sold under the coined name. Analyses of these products were made and the actual value compared with the claims made for them, the results showing that these mixtures usually consist of the cheapest and commonest ingredients known to the medical profession. The patient, on the contrary, is led to believe from the advertisement that the products sold under these coined names are new and rare and that the remedy is a panacea for consumption, Bright's disease, asthma, etc., when, as a matter of fact, the medicines do not contain any agent which could be looked upon as possessing any curative properties for these diseases. Such remedies are plainly fraudulent and harmful, since the patients are led to use them and thus lose valuable time which might be employed by resorting to proper treatment.

HARMFUL EFFECTS OF ACETANILID, ANTIPYRIN, AND PHENACETIN.

Prosecutions under the Food and Drugs Act developed the fact that there was much difference of opinion as to the harmful nature and effect of acetanilid, antipyrin, and phenacetin. In one case one physician testified that whereas he had formerly used acetanilid rather freely, he now prescribed it very guardedly, because of the unexpected and untoward effects which had been found to follow its use; another stated that he employed it to good advantage, and that though he often noted " bluing of the skin " he regarded this symptom merely as a signal or warning as to the further administration of the drug. It was, therefore, decided to make a thorough investigation of this subject, both by correspondence with physicians and by a survey of the medical literature. Four hundred responded and the data so supplied constituted a part of a publication issued on this subject.

The number and nature of poison cases, deaths, and habitual use of these commodities, as recorded in the medical literature, are also given, proving conclusively that these drugs are unsuitable and dangerous for use in proprietary medicines without medical supervision.

It seems, however, that the number of headache mixtures is increasing daily. It is true here and there a certain brand is discontinued, but new ones are introduced. The essential ingredients in these mixtures are acetanilid, acetphenetedin (phenacetin), antipyrin, monobromated camphor, caffein, sodium bicarbonate, ammonium carbonate, bromids, codein, and those mixtures that possess laxative properties, containing, in addition, effervescent material which consists chiefly of citric acid or tartaric acid and bicarbonate of sodium. During the past year about 350 samples have been collected, a large number of which have been analyzed. Some of these mixtures are taken in very large doses, and the amount of harm done to the public by their use can not be estimated, though some idea may be obtained by reading the data collected and published. While the ingredients present in these commodities may not be harmful when used under proper medical supervision, their promiscuous and indiscriminate use frequently produces poisoning, drug addiction, and in some cases even death.

MEDICATED SOFT DRINKS.

During the fiscal year ending June 30, 1908, approximately 80 samples of medicated "soft" drinks were examined. Since that time additional official samples have been collected of such products, and in 13 such samples the presence of cocain was established. It is true in most cases the amount of cocain is small, but the presence of such a deleterious agent in a beverage sold without restraint, and to children as well as adults, must be considered as illegal and very harmful, irrespective of the amount present. Very small quantities of cocain undoubtedly affect the nervous system of many individuals, and in many cases where the drug habit has been broken off the individual is liable to be unbalanced by the very small quantity he may obtain through the consumption of several glasses of a beverage containing this dangerous and habit-forming drug. In some cases the quantity of cocain present is declared upon the barrel, keg, or jug, but this information does not come to the attention of the public. The addition of cocain to a food product is undoubtedly one of the most pernicious practices in vogue.

SO-CALLED DRUG ADDICTION CURES.

There are about 35 institutions, combinations, or individuals engaged in the practice of treating drug addiction, opium, morphin, cocain, etc., by sending to persons addicted a treatment with instructions. In some cases these packages contain as much as 32 grains of a morphin salt to the fluid ounce. In other words, a 4-ounce bottle would contain enough of this poisonous, habit-forming agent to kill at least 100 men. Such mixtures are sent from one State to another, in many instances not only in violation of the federal law, but also in violation of the laws of the State, Territory, or the District of Columbia, from which or into which they are shipped. Seldom is a "poison" label attached to any of them. In other instances from 10 to 18 bottles are sent, the bottles being marked from 1 to 10 or 18, respectively, and every bottle containing the same amount of the habit-forming agents, though the treatments purport to gradually decrease the dose. For example, one treatment consisted of 10 bottles marked as indicated, and the amount of morphin and dionin present in an ounce of the material was 4 and 2⅔ grains, respectively, in each bottle. Another treatment sent out contained 16 grains of morphin sulphate and 8 grains of dionin, the latter being a derivative of morphin and possessing similar habit-forming properties. Many of the promoters of these remedies carry on their letter head the names of a number of prominent individuals or persons connected with philanthropic work who are represented as indorsing the treatment. An investigation showed that most of these persons are dead, and such as are still living have never authorized the promoter to represent to the public that they have indorsed the medicine in any shape or manner. A number wrote that according to the information brought to their attention the treatment apparently is accomplishing beneficial results.

The Drug Division has obtained the full treatments given by nearly all persons or firms claiming to cure drug addiction through the mail. It has also in its possession a number of samples of cocain sent by wholesale druggists and physicians to persons in the District of Columbia. The selling of these commodities in the District of Columbia is in violation of the law.

MISCELLANEOUS COOPERATIVE WORK.

At the request of the General Supply Committee, 26 samples of beeswax and 8 samples of paraffin were examined, with the result that all of the paraffin was found to be satisfactory, but 14 samples of the beeswax were either adulterated or pure substitutes. The beeswax present varied from 25 to 50 per cent of the whole, the remaining portion being paraffin, stearic acid, and other waxes. It is also of interest to note that some of the most highly adulterated samples are quoted at the highest prices. For example, the price of adulterated yellow beeswax varies from 18 cents to 45 cents per pound, the latter price being the highest quoted. In the case of white beeswax, the prices vary from 24 cents to 60 cents per pound for the adulterated product, while the highest price quoted for a pure product is 46 cents. It is apparent that the price for which an article is offered is no criterion on which to base a judgment as to its purity. Out of this practical work has grown a study, in cooperation with the Bureau of Entomology, on the constants of pure beeswax. The Bureau of Entomology supplies the Division of Drugs with authentic specimens of beeswax collected throughout the United States and foreign countries. So far 25 samples have been obtained, 12 of which have been analyzed. The results indicate that the constants of pure beeswax are uniform, irrespective of the location or kind of bees producing it, contrary to the claims made at times by manufacturers and dealers.

The chairman of the committee on the Drug Market of the American Pharmaceutical Association submitted for examination 10 samples of turmeric, purchased on market, with the result that 5 were found to be adulterated, 2 were barely up to the standard, and 3 were of excellent quality. These samples were purchased in the open market in Boston.

DRUG LEGISLATION IN THE UNITED STATES.

Various federal, state, territorial, and other laws governing the sale and labeling of drug products in the United States and its territories have been compiled and issued. The laws in general prescribe the qualifications necessary for a pharmacist to engage in the practice of selling medicinal agents, regulate the sale of poisons and narcotics, and forbid the sale of adulterated and misbranded drug products. It should be noted that at present there is no federal law which prohibits unregistered or unlicensed persons from sending into interstate commerce such commodities, although they can not be sold locally by them, nor indiscriminately even by registered or licensed pharmacists or physicians. It is believed that the state laws will reach some of the offenders, but in order to establish this fact it will be necessary to bring a number of cases.

SYNTHETIC PRODUCTS.

The principal lines of work conducted by the Synthetic Products Laboratory during the past fiscal year are as follows:

There were examined 108 interstate and 8 import samples, including preparations for the treatment of headache, neuralgia, la grippe, rheumatism, etc., 35 of the interstate samples proving to be illegal. This work is part of a comprehensive scheme to investigate all headache remedies and other preparations containing (synthetic) habit-forming drugs, such as dionin, heroin, acetanilid, antipyrin, pyramidon, acetphenetidin (phenacetin), caffein, etc.

Research work on headache mixtures was inaugurated in 1908 with a view to establishing reliable methods for estimating the constituents present in preparations containing caffein, acetanilid, acetphenetidin, etc. After the tabulation of the analytical data now on hand, it is believed that the methods for the separation and estimation of acetanilid and caffein in headache mixtures will have been practically perfected. Some investigations were also made looking to the recovery of caffein when occurring in or introduced into various vegetable and animal tissues.

During September and October the chief of this laboratory investigated the conditions involved in the manufacture and sale of certain synthetic drugs in Germany and Switzerland, more especially, however, the process now in vogue for making acetphenetidin (phenacetin). It developed that this drug is no longer made in quantity from phenol (carbolic acid), the view quite generally prevailing in this country and found in much of our chemical literature. On the contrary, the method now most commonly employed for producing this commodity has as its starting point the well-known substance benzol. The isomeric chlornitro benzols resulting in this process of manufacture find ready employment in the preparation of certain dyestuffs. The presence of chloracetanilid frequently detected in some brands of phenacetin is readily explained from the fact that the manufacturers in question did not take the precaution to properly purify their crude aethoxynitrobenzols.

PHARMACOLOGICAL RESEARCH.

Much attention has been given to the equipment and organization of the Pharmacological Laboratory. The outfit was planned to insure both economy of time and accuracy in the work. The apparatus and appliances include holders for large and small animals, two kymographs, mercurial manometers, oncometers, apparatus for the perfusion of the heart, a full equipment of surgical instruments for aseptic operations on animals, apparatus for the study of muscular changes, cages for small animals, and four cages for dogs, constructed so as to collect the excreta separately. The Pharmacological Laboratory will be equipped for the study of the action of drugs on circulation, respiration, muscles, secretion, metabolism, etc.

Researches carried on are as follows:

Studies on flour.—(1) Chemical. Both alcoholic and aqueous extracts were prepared from unbleached, commercially bleached, and overbleached flours containing up to 50 milligrams of nitrogen, calculated as sodium nitrite per kilogram of flour. Some extracts were also made from flour which had been treated with nitrogen peroxid until it assumed a distinct yellow color. About 50 different extracts were prepared.

(2) Physiological. Experiments included the feeding of the extract to rabbits, intraperitoneal injections into guinea pigs, and studies of the effects of extracts of bleached and unbleached flour on blood pressure in dogs. A large number of experiments have already been performed, but the work is not yet completed.

Studies in the pharmacology of caffein.—(1) Experiments on tolerance to caffein performed on rabbits and dogs are nearing completion.

(2) An extended series of observations has been made of the toxicity of caffein on rabbits, dogs, cats, pigeons, guinea pigs, and frogs, and is nearing completion.

(3) Some experiments have been made on the effect of caffein on the toxicity of acetanilid, including studies on blood pressure. As soon as time will permit, this investigation will be extended to antipyrin, phenacetin, and alcohol, all of which are supposed to counteract the effects of caffein in the body.

(4) The fate of caffein in the body, a subject of absorbing interest from a theoretical but more so from a practical standpoint, has been studied with reference to its elimination in the bile of dogs and rabbits and decomposition in the liver.

(5) An investigation on the production of caffein glycosuria in rabbits, dogs, and guinea pigs is in progress. The experiments on the effect of calcium chlorid on caffein glycosuria in rabbits have yielded very interesting results.

(6) Studies have also been conducted on the effect of caffein on protein metabolism, with special reference to high and low protein diet and the elimination of kreatinin, but no satisfactory results have as yet been obtained.

Toxicity of the alcohols.—Experiments on the comparative toxicity of ethyl and amyl alcohol have been carried out on frogs and rabbits, and studies on blood pressure have been made on dogs and cats.

Experiments with bovinine.—A study on the effect of bovinine has been made by feedings and intraperitoneal injections into rabbits, feeding experiments with dogs, and absorption from the stomach in the case of dogs.

Physiological testing and control of methods.—A number of samples have been tested physiologically for the presence of various constituents. A good deal of time has been devoted to a critical study of methods used in analysis in connection with metabolism work on animals to facilitate future work and insure greater accuracy of results.

MISCELLANEOUS CHEMICAL INVESTIGATIONS.

STUDIES CONDUCTED BY THE MISCELLANEOUS DIVISION.

SCOPE OF WORK AND NUMBER OF DETERMINATIONS.

By order of the Secretary, the Miscellaneous Division was created July 1, 1908, four laboratories and one section being organized, as follows: Water Laboratory, Cattle Food and Grain Investigation Laboratory, Insecticide and Fungicide Laboratory, Trade Waste Laboratory, and Hygienic and Miscellaneous Section.

This expansion and reorganization was necessary for the proper execution of the work assigned to this division under the Food and Drugs Act, and because of the growth of the several lines of investigation which previously had occupied the attention of the Miscellaneous Laboratory.

To the Water Laboratory, formerly the Insecticide and Water Laboratory, is assigned the examination, under the Food and Drugs Act, of bottled mineral and table waters, foreign and domestic, found on our markets; the examination of public water supplies for the purpose of detecting causes of pollution and suggesting remedies for correction of the same; the examination of waters for irrigating and technical purposes, and the examination of samples from source of all the important mineral springs of the United States.

The Cattle Food and Grain Investigation Laboratory examines samples of cattle and poultry foods and remedies collected under the food law, and is also charged with the investigation of such economic problems as the feeding value of range forage crops, the feeding value and adaptability of grains, the milling quality of cereals, and the effect of bleaching on flour.

The Insecticide and Fungicide Laboratory investigates the composition and methods of manufacture of insecticides and fungicides and their effect when sprayed upon foliage, with the idea of increasing the efficiency of these products and also suggesting methods by which injury to vegetation may be avoided.

The Trade Waste Laboratory studies the relation of the disposal of harmful trade waste to agricultural operations. Particular attention has been given to the injury produced by smelting and mining operations.

The hygienic work includes investigations relating to public health; that is, the examination of wall papers and fabrics for poisonous or deleterious materials, the examination of poisons and poisonous substances in common use, the composition of the atmosphere of schools, public buildings, railroad cars, etc. The work of the miscellaneous section also includes investigations of an official and public nature which may be properly made by this Bureau but are not provided for in other established laboratories.

The administrative work and correspondence relating to the proper enforcement of the Food and Drugs Act, as applied to mineral and table waters and to cattle and poultry foods and remedies, has greatly increased during the year, and together with the preparation of cases recommended for prosecution to the Board of Food and Drug Inspection occupies a great portion of the time of the chief of the division. The traveling necessary in the study of the effect of smelter wastes on agriculture has also consumed considerable time. During the year 2,092 samples, requiring approximately 15,000 determinations, have been examined, as follows:

Imported mineral and table waters	92
Domestic mineral and table waters	412
Miscellaneous waters	142
Imported cattle and poultry foods and grains	157
Domestic cattle and poultry foods and grains	269
Miscellaneous feeds and grains	164
Insecticide and fungicide samples	203
Trade waste samples	335
Miscellaneous and hygienic samples	318
Total	2,092

About one-third of these examinations have been made at the request of the several divisions and bureaus of this Department, and for other Departments of the Government according to the following classification:

War Department	9
Department of Commerce and Labor	18
Department of Justice	115
Isthmian Canal Commission	2
United States National Museum	1
Government Printing Office	2
Commissioners of District of Columbia	25
Department of Agriculture:	
Bureau of Plant Industry	238
Bureau of Entomology	184
Bureau of Forestry	3
Bureau of Animal Industry	2
Irrigation and Drainage Investigations	6
Total	605

WATERS.

During the year 646 samples have been examined in the Water Laboratory, 92 being foreign mineral waters, of which 17 were recommended for exclusion from entry into the United States because of false and misleading statements on the labels. Four hundred and twelve interstate samples of bottled mineral and table waters were examined. Continuing the investigation of mineral springs at source, 62 waters have been subjected to complete analyses. Eighteen complete analyses have been made of waters from fish-hatching stations, this work being performed by request of the Bureau of Fisheries of the Department of Commerce and Labor. Miscellaneous analyses made during the year for other branches of the Government service were as follows: War Department, 7; Isthmian Canal Commission, 1; Government Printing Office, 2; Bureau of Plant Industry, 20; Bureau of Entomology, 7; Irrigation and Drainage, 6; Forestry Service, 2. Twenty-five samples of gas were examined incident to an investigation made at the request of the Commissioners of the District of Columbia. As time has permitted, two lines of original research begun last year have been continued, namely, the study of the methods for determining small amounts of lithium and a study of the radioactivity of mineral springs. Both of these investigations have an important bearing on certain aspects of the enforcement of the food law.

CATTLE FOOD AND GRAIN INVESTIGATIONS.

This laboratory has examined during the year 590 samples, 269 of which were samples of commercial feeding stuffs obtained by inspectors on the market and analyzed to determine their compliance with the provisions of the food law. Sixty samples were found adulterated or misbranded, and prosecution has been recommended to the Board of Food and Drug Inspection. There have also been examined 157 imported samples, including oats, barley, wheat, cottonseed meal, barley sweepings and cleanings, pea meal, etc., to determine whether entry into this country should be allowed.

In cooperation with the Office of Grain Investigation of the Bureau of Plant Industry 5 wheat and 58 sorghum samples have been analyzed, and for the Office of Farm Management 52 samples of hay have been examined and 2 of alfalfa. Forty-six additional miscellaneous samples were analyzed for various bureaus and laboratories of the Department.

INSECTICIDES AND FUNGICIDES.

Two hundred and three samples of insecticides, fungicides, and weed killers have been examined by the Insecticide and Fungicide Laboratory, and considerable work along related lines has been performed in cooperation with the Bureaus of Entomology and Plant Industry. Numerous samples of soluble oils and proprietary insecticides have been examined at the suggestion of the Bureau of Entomology to determine the commercial cost of preparation of these articles, and it was found in some cases that the price asked was out of all proportion to the value and cost of the material.

The investigation of lead arsenate, which was begun last year, has been completed. The method of manufacture of lead arsenate and the effect on the character of the finished product of impurities contained in the raw materials have been studied exhaustively. The possibilities of homemade lead arsenate and the effect of different lead arsenates and the various impurities therein on tender foliage have been investigated, as has also the quantity of arsenic remaining on the ripe fruit of trees that have been sprayed. A bulletin embodying the results and conclusions has been prepared, and it is believed that the information will be not only timely but of great value to the farmer and the orchardist as well as to the manufacturer of this product. An investigation of the toxic effect of certain materials, notably copper and arsenic, on plants which are sprayed with combinations of these substances has been undertaken. Some apprehension exists among orchardists that the excessive use of lead arsenate may cause an accumulation of toxic salts in the soil and result in serious injury to the trees. This matter is receiving special attention.

In collaboration with the Bureau of Entomology, an investigation of the efficiency of sodium cyanid as a substitute for potassium cyanid in fumigating operations has been begun. The proper proportions of cyanid, acid, and water to be used to obtain the highest efficiency of hydrocyanic-acid gas will be determined, as will also the effect of any impurities which these reagents may contain on the foliage and on the amount of hydrocyanic acid formed from a given amount of potassium cyanid. This work is nearly completed, and results have been obtained which it is believed are of considerable economic importance.

TRADE WASTES.

The Trade Waste Laboratory, under the immediate charge of the chief of the division, has examined 335 samples. One hundred and fifteen of these were obtained in cooperation with the Bureau of Forestry, at the request of the Department of Justice, and constitute a part of the study begun the previous year to determine the injury to vegetation, particularly within forest reserves, produced by the fumes and refuse of smelting operations.

The effect of certain gases and toxic salts, produced as a result of mining and smelting operations, on greenhouse and field specimens has been studied under such conditions that the quantity of the several materials used could be accurately determined and the results exhaustively investigated. Part of the investigation of conditions in the vicinity of the smelters at Anaconda, Mont., has been completed and the results prepared for publication, while other studies of a similar nature are also nearing completion.

MISCELLANEOUS AND HYGIENIC SECTION.

The miscellaneous and hygienic work for the year has resulted in the examination of 318 unclassified samples, quite a number of which were for other Departments of the Government service as well as for the several bureaus and offices of this Department.

INVESTIGATIONS OF THE LEATHER AND PAPER LABORATORY.

The leather and paper investigations have been seriously impeded because the specially trained men necessary for these lines of work can not be secured. It has therefore been necessary to train chemists for these investigations, after which they have resigned in several instances to accept more remunerative commercial positions. Nevertheless the work of the laboratory has steadily increased, as is shown in the following summary of samples handled during the year:

Paper and paper-making materials, Washington	3,844
Paper and paper-making materials, Dayton laboratory	1,459
Leather and leather-making materials	32
Turpentine, tars, oils, and wood products	416
Miscellaneous	63
Total	5,814

The extent to which these examinations are called for by other Departments is shown by the fact that of the total 5,814 samples, 4,849 were made for other branches of the Government, of which 1,559 were paper examinations for the Government Printing Office and 2,528 papers and leathers examined for the Post-Office Department.

PAPERS AND PAPER-MAKING MATERIALS.

Paper tests are regularly made for the Post-Office Department, both in Washington and at Dayton, Ohio, for the Government Printing Office, for the Treasury Department, for the General Supply Committee, for the Isthmian Canal Commission, and for other branches of the Government. Special investigations were made for the Post-Office Department in connection with the purchase of postal cards and for the General Supply Committee to assist in the awarding of contracts. This laboratory has now the equipment, force, and experience necessary for testing all papers purchased by the Government and is in a position to prepare specifications and test the deliveries in such a manner, it is believed, that the cost will be much decreased and the interests of the Government better served.

Paper-making materials not now in general use and pulps made from them have received attention. No material has so far come to the attention of the Bureau which, under present conditions, can compete with rags, wood, straw, and the commonly used fibers in quality or in cost of papers made therefrom, except possibly under special local conditions. The need of a substitute for wood from which paper equal in quality and as cheap can be made is evident to all. Many have recently turned their attention to supplying this material, and there is grave danger that through the excessive enthusiasm, or less worthy motives, of the exploiters of such alleged materials, many uninformed persons may invest in ventures which will of necessity fail financially. This is not probable in the case of experienced paper makers, but it is likely to occur where the people of a community who know nothing about paper making are persuaded to invest in establishing a new industry which theoretically looks exceedingly promising. It should be borne in mind that experienced paper makers have made practical tests with most of these suggested materials and found them unprofitable.

TURPENTINE.

Approximately 300 samples of spirits of turpentine have been examined in connection with the administration of the Food and Drugs Act, June 30, 1906. The purpose of this examination was not only to determine how extensive is the practice of adulteration, but to learn at what stage of marketing this article is adulterated; whether by the producers, the primary buyers, or the wholesalers and retailers. The samples were collected from all parts of the United States and from dealers in paints and oils who sell largely to druggists. It was found that but few samples collected from producers were adulterated, but about 20 per cent of the samples from the stock of primary buyers and about 27 per cent of these from the stock of wholesale and retail dealers were sophisticated; or, in other words, about 20 per cent of the samples collected were adulterated. The average amount of adulterant present was 6.5 per cent, though many of the samples contained 20 per cent and some as much as 75 per cent of mineral oil. An adulteration of 6.5 per cent of mineral oil reduces the market value between 80 cents and $1.20 per barrel, and the purchaser of the oil is defrauded to that amount. The percentage both of adulterated samples and the amount of adulterant present is greater in samples taken from the wholesale and retail dealers than in samples taken from primary buyers. The results, on the whole, show a serious sophistication of spirits of turpentine now found on the American market.

Experiments on an industrial scale in the refining of wood turpentine, both by steam and destructive distillation, have been conducted, using two forms of column stills. It was found that while a wood turpentine of superior quality can be thus produced, it is not possible to secure a sharp separation of oils having a given boiling point. That is, if all the oils boiling below 170° C. are distilled, a small percentage of oils distilling above 170° C. is also carried over. Further work with these various products, such as paint and varnish thinners, is being done on a practical scale. The laboratory continues to test samples of tars, pitches, and turpentines at the request of other Departments.

LEATHERS.

The investigations on leathers have been continued. Sole and rough leathers of different tannages are being analyzed and tested to determine the factors that control quality, but no conclusions have as yet been reached. Work on leathers has also been done at the request of the several Departments, and an investigation of bag and belting leathers has been begun as a result of these inquiries. The studies on tanning materials have been confined to native materials, work on American sumacs and on the tannin content of barks at different seasons of the year being under way. The leather and tanning work has been handicapped most severely for lack of men trained in the testing and examination of these products.

MISCELLANEOUS WORK.

Miscellaneous samples, including fertilizers, peats, oils, soaps, and other industrial materials, have been examined during the year for other bureaus of this Department and for other Departments.

EXAMINATION OF SUPPLIES FURNISHED ON CONTRACT.

This work is done in the Contracts Laboratory, being conducted along the same lines as in the past, with the exception that there has been a greatly increased demand for tests of contract supplies, the number of samples being more than double that of the preceding year. This increased demand has taxed the resources of the laboratory to the utmost, so that very little research work was possible, although the field afforded for such investigations is practically unlimited, owing to the miscellaneous character of the supplies offered for examination and their complexity of composition. A method for the rapid analysis of Babbitt metal has been developed and considerable work has been done on the study of other methods for testing the various materials examined.

The laboratory has been working for several years on testing paint and varnish materials, and during the past year 1,076 samples of these materials were analyzed, most of which were examined at the request of other Departments. The chief of the laboratory has acted as a member of an inspecting committee on an extensive series of exposure tests of paints on wood and also on iron and steel, conducted by an association of paint manufacturers, which promises to be very instructive. Though these experiments have not been under the control of this laboratory, an unusual opportunity has been offered for the discussion of paint problems with experts representing both consumers and manufacturers.

The 2,606 samples examined during the year are classified in the following table to show the more important kinds of materials analyzed and for which branches of the Government the work was done. In addition, this laboratory has examined 5,511 pieces of apparatus, of which only 399 were rejected, which indicates that the inspection of apparatus, which has gradually been developed, has resulted in a decided improvement in the quality of material sold to the Bureau.

Number of samples of contract supplies analyzed.

Department requesting analysis.	Paints and varnishes.	Oils, fats, grease, and waxes.	Metals and alloys.	Soaps and candles.	Ink.	Typewriter ribbons.	Dry colors.	Rubber.	Glue.	Chemicals.	Boiler compounds.	Miscellaneous.	Total.
Isthmian Canal Commission	189	160	170	25				75		40	17	93	769
General Supply Committee	512	75		29	20	69			37				742
Treasury Department[a]	3	94	32	42	3		295		44			13	526
Commissioners, District of Columbia	253	57											310
Department of Agriculture[b]	118	34	9	16		4						14	195
Government Printing Office		38			2								40
Post-Office Department	1				9								10
Interior Department		5											5
War Department				3									3
Department of Commerce and Labor			3										3
Navy Department								1				1	2
Department of Justice					1								1
Total	1,076	463	214	115	35	73	295	76	81	40	17	121	2,606

[a] Including Bureau of Engraving and Printing.
[b] Including Bureau of Chemistry.

MICROCHEMICAL INVESTIGATIONS.

The investigations of the Microchemical Laboratory have been, as in former years, largely conducted in collaboration with other laboratories and branches of the government service. Routine work, supplementing chemical analyses by the microscopical examination of samples, occupies much time, though several lines of research work have been pursued. Samples of mustards grown last season were collected when mature, and as soon as opportunity permits the microscopical work on them will be done to establish characteristics for their identification and the detection of adulterants.

Considerable attention has been paid to the investigation of eggs stored in various methods to provide means of identification of the storage product when offered for sale. The dried egg products have also been studied and both lines of work are of importance in the enforcement of the Food and Drugs Act.

The investigation begun last year on alkaloids has been continued, with most encouraging results. Up to the present time over 40 compounds, natural or synthetic, have been studied more or less thoroughly, and the data are being used regularly in the identification of alkaloids or of some of their derivatives in drug and food products.

In connection with the analysis of certain products made wholly or in part from nuts it was found necessary to make a study of many varieties for the purpose of developing histological methods for their identification, and the results of these investigations are being used practically at the present time in the examination of such products.

A microscopical study has also been made of a few substances offered for paper making, though the most of the work on papers has been in their routine examination for the several branches of the Government. These samples have come mainly from the Government Printing Office, Post-Office Department, General Supply Committee, and the Bureau of Engraving and Printing. The determination of the quantity and quality of the pulp entering into the manufacture of envelopes for the Post-Office was an important feature of this work.

The food work has covered a large variety of samples, including nutmegs, coffees, cocoa and chocolates, tea, rice, nuts, honeys, peppers, peas, and miscellaneous products.

The general work on cattle foods and grains has consisted largely in the investigation of imported samples, the most important point being the detection of poisonous weed seeds.

While the microscopical examination of paint pigments is not always of service, still certain points regarding their character can be determined by such an examination, and over a hundred samples, including lampblacks, chrome greens, yellows, white and red leads, were so tested.

The work on interstate samples in connection with the operation of the Food and Drugs Act has required the examination of over 800 samples and included a large variety of substances, such as eggs, cocoas, coffees, flours, peppers, ketchups, jellies, and yeasts. Of stock feeds the list includes whole grains, such as oats and wheat, as well as simple ground feeds and a large number of compound feeds made of mixtures of various ingredients. Of interstate samples of drugs, various alkaloidal residues have been identified and also many powdered drug products, as well as such materials obtained from medicinal products. About 240 photomicrographic negatives have been made, mostly in connection with the studies on nuts and alkaloids. A classified list of the various samples analyzed during the year is as follows:

General samples.

Papers	3,491	
General food samples	658	
Stock feeds	158	
Pigments	124	
Drugs	149	
Unclassified samples	79	
Total		4,659

Interstate samples.

Foods	427	
Stock feeds	144	
Drugs	314	
Total		885
Sum total of samples for year		5,544

NITROGEN DETERMINATIONS.

The section devoted entirely to nitrogen work, which plays so important a part in many examinations, especially in determining quality in the administration of the food law and in metabolism experiments, has made 12,000 such determinations on samples from all divisions of the Bureau and from the Bureau of Plant Industry, exceeding by 3,250 the figures for the previous year. Investigations for the improvement of methods used in the determination of nitrogen have been continued.

FOOD AND DRUG INSPECTION.

The inspection work of the Bureau in the enforcing of the Food and Drugs Act of June 30, 1906, is specifically assigned to an inspection force of 39 men under a chief inspector with headquarters at Washington, to a food and a drug inspection laboratory at Washington, and to 21 branch laboratories in various parts of the United States, including 1 in Honolulu.

THE FOOD AND DRUG INSPECTORS.

During the fiscal year 1909 the food and drug inspectors continued the inspection work on the same general lines as in the preceding year, collecting samples suspected to be adulterated or misbranded and investigating factory practices. The number of inspectors remains the same, and, with a very few exceptions, the assignment of stations has been unchanged. The installation of a laboratory at Nashville, Tenn., caused the abandonment of the inspector's post at Memphis and his transfer to Nashville. In order to make a more equal distribution on this account, the inspector at Knoxville was transferred to Charleston, W. Va., and the inspector at Birmingham, Ala., to Atlanta, Ga. The amount of work at New Orleans, Chicago, and Cincinnati required the assignment of an additional inspector to each of these cities, making five laboratories altogether, including New York and Boston, where two inspectors are stationed, a plan which might be followed to good advantage at other strategic points if the force were sufficiently strong numerically to permit it.

A civil-service examination for food and drug inspectors was held by the Civil Service Commission on May 5 and 6, and two appointments have been made from this list to fill vacancies caused by resignations.

The major portion of the year's work consisted in the collection of food and drug samples for examination and in the inspection of factories engaged in interstate traffic. About 1,300 factories have been inspected, and the number of samples collected amounts approximately to 15,000. The class of products sampled was similar to those obtained during the fiscal year ended June 30, 1908, namely, extracts, spices, olive and salad oil, milk, liqueurs, wines, whiskies, molasses, vinegar, diabetic and gluten flours, maple and cane sirups, coffee, cheese, honey, breakfast foods, misbranded morphin and cocain preparations, and drugs labeled as cures. To this list have been added preserves, jams, fruit butters and jellies, and a great many powdered drugs, besides those drug samples requested specifically from time to time by the Division of Drugs. Coordinately with the submission of official samples, each inspector is required to forward a report giving an inventory of the stock in possession of the consignee and detailing the nature of interstate delivery in order that condemnation proceedings may be instituted, provided that the sample indicates that the goods are adulterated or misbranded. In this manner more than 200 recommendations for seizures have been referred to the Board of Food and Drug Inspection, of which 185 were approved.

In seizure cases it is usually necessary, in order to make proper identification of the product before attachment, that the inspector originally reporting the matter should proceed to the point of destination and acquaint the district attorney with all of the detailed facts in connection with the sale and interstate shipment. In addition to procuring copies of label and other records pertaining to the case, assistance in making the seizure is given in connection with every case. A large number of criminal prosecutions have been referred to various district attorneys within the past year. These prosecutions, whenever practicable, have been instituted against the manufacturer.

During the months of August and September, 1908, concerted milk campaigns were held at Kansas City, Chicago, and Cincinnati, at which more than 1,500 samples were collected, resulting in convictions and assessments of fines against shippers of adulterated milk to those points.

Assistance has been rendered the Division of Foods in making a special investigation into the methods and practices of plumping oysters; aid has been given in the same manner to the sugar laboratory in connection with its investigation of the maple-sirup industry. General investigations have been made concerning the canning and the cheese industries, particularly in New York and Ohio, and special examinations have been made in regard to the source and sanitary condition of mineral and spring water and the canning and packing of herring roe along the Potomac River. The inspectors have submitted reports on food supplies furnished to various hospitals and navy-yards at the request of the Navy Department; also on the character of foods furnished to inmates of charitable institutions. A special examination was made of the sanitary condition of bakeries offering products in interstate commerce.

The investigation of the coffee situation has been continued, with particular reference to the quantity of imported coffee and the sources of importation, in order to devise some means of suppressing the practice of indiscriminately labeling inferior coffees as Mocha, or Java, or blends of the two. A number of prosecutions, including the seizure and condemnation of large shipments of coffees so misbranded, have been reported during the past year, with the result that the mislabeling and sale of these brands have been largely reduced.

In connection with the Miscellaneous Division, extensive inquiry has been made into the practice of marketing misbranded and adulterated stock feed, and prosecutions have been brought under sections 2 and 10 of the act for the adulteration of oats with barley, the addition of material low in feeding value to various grades of feeds, or gross misbranding with reference to protein and fat content.

The matter of artificial ripening of Florida fruit and the shipment to northern points of fruit imported into Florida and labeled in a manner to indicate that it was a product of Florida has been looked into in a preliminary way in order to develop some plan for a full investigation. Attention has also been given to vinegar factories which manufactured certain classes of imitation apple-cider vinegar, resulting in frequent confiscations and the institution of criminal prosecutions based on the interstate shipment of distilled colored vinegars labeled as " Pure Apple Vinegar," or " Cider Vinegar."

An inquiry into the practices of commission merchants and wholesale egg dealers in preparing and shipping for bakers' use desiccated and canned eggs, consisting in whole or in part of " spots," or eggs in the first stage of decomposition, is under way, as well as a general inspection of all mills engaged in bleaching flour intended for interstate commerce.

WORK OF THE WASHINGTON FOOD INSPECTION LABORATORY.

The Washington Food Inspection Laboratory has as its special object the checking of the analytical work of the branch food inspection laboratories and the examination of food-inspection samples taken in the vicinity of Washington under the Food and Drugs Act of June 30, 1906. During the year ending June 30, 1909, much work was done in checking the various methods of analysis, statement of results, and analytical work of the branch inspection laboratories in an effort to bring about uniformity of practice.

The total number of samples examined during the year was 2,600, half of which were samples of imported foods taken at the various laboratories and 200 of which were miscellaneous samples for experimental work. All the analytical reports on food products from other laboratories, with the exception of flavoring extracts, dairy products, stock feeds, grains, and waters, pass through this laboratory for examination and the preliminary selection of cases for prosecution is made, these cases being then prepared for the consideration of the Board of Food and Drug Inspection. Analysts of the laboratory are called on to testify in court on cases brought under the Food and Drugs Act.

An investigation was begun at the commencement of the fiscal year of the methods of handling distilled spirits, and the study of the changes taking place in storage under varying conditions has been continued. To this end, 60 barrels of whisky, part of which has been stored in an experimental warehouse in Louisville and part in the various distillery bonded warehouses in different sections of the country, have been under observation and samples analyzed from time to time. The investigation of methods for the analysis of distilled spirits has been continued, with the result of further improving the methods for the determination of fusel oil and the estimation and separation of coloring matter. Similar investigations of the composition of rums, and of the composition of pure cider vinegar, including the methods of manufacture used in this country, are under way, information being especially needed in the latter case for the enforcement of the Food and Drugs Act. During the year a study has also been made of the composition of extracts of coffee, occasioned by the necessity for information as to the proper labeling of certain imported products.

The analytical methods used in foreign countries to test American food products have been investigated in order to bring about some international agreement as to the methods for testing fats and oils. The necessity for this work can not be overestimated, as this country exports great quantities of animal and vegetable fats and oils, the value of which is based on chemical analysis, and much trouble has arisen in the past over the nonagreement of analytical results, due largely, if not entirely, to the use of different methods.

EXAMINATION OF DOMESTIC AND IMPORTED DRUGS IN THE WASHINGTON DRUG INSPECTION LABORATORY.

The Washington Drug Inspection Laboratory, established July 1, 1908, examines all samples of drugs for which special provisions have not been made.

Domestic drugs.—During the past year 936 samples of domestic drug products have been examined, of which 860 were collected to test their legality under the Food and Drugs Act and 76 for study. One hundred and fifteen of the former were referred to the Board of Food and Drug Inspection as being illegal. A number of consignments of drugs were seized on libel proceedings for condemnation, it being found that they were either adulterated or misbranded within the meaning of the law.

The violations met with have been largely misrepresentations appearing on the label of the carton or bottle, or in the accompanying literature, and the absence or incorrectness of the declaration of alcohol, opium, morphin, cocain, acetanilid, chloroform, etc. Gross adulteration of various powdered drugs has also been found, and the numerous analyses made of so-called "cancer" and "drug addiction" cures have disclosed much fraud.

Imported drugs.—Of the 1,220 samples of imported drugs analyzed in this laboratory, 495 represent samples of consignments taken by the various port laboratories and subsequently released without prejudice pending further investigations as to their conformity to the law. Seven hundred and five of the 1,220 samples represent consignments which were found to be illegal. Certain precedents have been established under which the port laboratories may act with reference to the disposition of detained shipments, but all cases without established precedents, together with appeals by the importers, are regularly referred to the Washington Drug Inspection Laboratory for investigation and recommendation. The character of violations is very largely the same as those encountered in domestic drugs, namely, false claims and misrepresentations on the labels of the cartons or bottles and in the literature accompanying the packages. The adulteration of crude drugs, however, is less frequent than when the law first went into effect. Various shipments of drug products which are considered dangerous to the health of the people of the United States are regularly excluded. Among these are inferior and deteriorated drug products, such as digitalis, henbane leaves, etc. Preparations, moreover, containing habit-forming drugs, such as cocain, morphin, codein, etc., and recommended for the treatment of afflictions peculiar to children are refused entry.

Special investigations have been made in cooperation with the Microchemical Laboratory relative to the identification of minute quantities of various alkaloids, with valuable results, a number of the common alkaloids used in the manufacture of medicinal preparations being positively identified by this means. Preliminary investigations have been made on a number of samples of absinthe to ascertain their actual composition, for the purpose of securing information which may be of service in determining whether or not these products are dangerous to the health of the people of the United States.

FOOD AND DRUG INSPECTION AT THE BRANCH LABORATORIES.

In addition to the food and drug inspection laboratories at Washington, 21 branch laboratories have been established in various parts of the United States, including 1 at Honolulu, for the purpose of conducting the greater part of the routine work and many of the investigations relating to the enforcement of the Food and Drugs Act. Four of these branch laboratories have been in operation only this year, the new laboratory established at Pittsburg having begun work in December, 1908; those at Omaha and St. Louis in January, 1909; and that at Nashville in June, 1909. The samples of foods and drugs collected by these laboratories in their respective localities are examined and hearings are called at the laboratory most convenient to the firms cited. The laboratories also form convenient headquarters for inspectors and for such analytical and field work as may be necessary in the investigations of the Bureau relative to the enforcement of the law.

Food and drug samples examined in the various branch laboratories during the fiscal year ended June 30, 1909.[a]

Laboratory.	Imported samples.				Interstate samples.			Miscellaneous samples.	Hearings conducted.
	Legal.	Illegal.	Total.	Floor inspection samples.	Legal.	Illegal.	Total.		
Boston	288	208 [b] 202	698	11,447	139	202	341	153	425
Buffalo	66	17	83	171	275	189	464	162	95
Chicago	179	142	321	2,520	1,409	640	2,057	8	469
Cincinnati					546	518	1,154	87	610
Denver	18	1	19		458	244	702		123
Detroit	59	7	66		259	141	400	62	216
Galveston	54	30	84	641	242	189	431	35	122
Honolulu	102	107	209	152				2	86
Kansas City	2		2		386	126	512		258
New Orleans	94	119	213	1,384	243	145	388	113	433
New York	2,827	1,690	4,517	44,388	360	380	740	589	2,338
Omaha[c]	11		11	3	184	77	261	38	130
Philadelphia	521	164	685	6,283	128	88	216	33	200
Pittsburg[d]	30	21	51	192	97	82	179		157
Portland	146	74	220	4,115	147	59	206	82	149
St. Louis[c]	1	4	5	70	185	98	283	48	391
St. Paul	70	19	89	302	206	84	290		[e] 140
San Francisco	[f] 465	303	768	6,149	256	201	457	[g] 64	[h] 232
Savannah	12	1	13	19	206	150	356	49	244
Seattle	298	124	422	1,412	130	64	194	118	83
Total	5,243	3,233	8,476	79,248	5,856	3,677	9,631	1,643	6,901

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[a] The laboratory established at Nashville, Tenn., is not included in this report.

[b] Released without prejudice pending further investigations.

[c] This report covers six months, as the laboratory has been in operation only since January 1, 1909.

[d] This report covers seven months, as the laboratory has been in operation only since December, 1908.

[e] Record of hearings includes only those held since January 1, 1909.

[f] Including 235 Chinese drugs.

[g] Collaborative work and commissary samples.

[h] Represents 163 samples.

BOSTON LABORATORY.

About two-thirds of the samples examined at the Boston laboratory are imported goods, totaling almost 700 samples, the most important classes of foods analyzed being dairy products, distilled liquors, fruit products, meat and fish, and spices and condiments. Over 60 per cent of the dairy products were declared illegal and over 45 per cent of the distilled liquors, the other classes named not exceeding 26 per cent of illegal shipments and usually being much less. Of the 341 interstate samples, about one-third of the oils and fats and spices and condiments were found to be illegal, over one-half of the dairy products, about 65 per cent of the saccharine products, and nearly three-fourths of the flavoring extracts. Of the 425 hearings granted, 71 were on dairy products and 41 on saccharine products, 34 each on drugs and flavoring extracts, and 35 each on cereal products and on distilled liquors. The following investigations are in progress or have been terminated in the Boston laboratory during the past year as having a direct bearing on the administration of the food law:

Vanilla extract.—Analyses have been made of several vanilla extracts made in the laboratory from the different kinds of commercial beans and also of 12 samples made by representative manufacturers under commercial conditions and by commercial methods from the standard quantity of beans. The kind of bean, the strength of alcohol, the other ingredients used, and the detailed conditions of manufacture were ascertained in the majority of cases. The leading numbers were fairly uniform even when the solids not sugar showed a wide variation.

Cocoa products.—Varnishes used in the manufacture of chocolate and other confections have been studied. Many of the manufacturers of plain or bitter chocolate in this country are using a varnish in finishing their retail package goods, which is usually applied by dipping the chocolate in an alcoholic solution of the material employed. These coatings differ widely in composition, shellac and rosin varnishes being more commonly used. Shellac is generally employed in the case of confectionery, and was found in percentages varying from 0.4 to 0.75 per cent on many cheap chocolates, chocolate cigars, peanut bars, and other penny goods. Cocoa shells in small quantities are still often found in cocoa products, and as some brands are free from shells it is apparent that their presence is due to faulty manufacture or to deliberate adulteration.

Benzoic acid.—The naturally occurring benzoic acid content of authentic samples of tytleberries from Norway and foxberries from Nova Scotia, members of the cranberry family, has been determined. The percentage present does not differ in a marked way from that found in our domestic cranberry. In an effort to shorten the time required for the determination of benzoic acid in food products, and, if possible, to improve upon the accuracy of the other methods, a procedure of double extraction, making use of ether and subsequently chloroform has been developed, which gives very promising results.

Color and egg content of bakers' products.—The investigation of the color and egg content of bakers' products, with special reference to cake, has been continued. About 75 per cent of the samples examined contained coal-tar colors, naphthol yellow S and the fast yellows being extensively used. In no case was a highly colored, bright yellow article found to contain more than one egg per pound, and in general these samples showed a much smaller content of egg than those of lighter color.

FISH.—Some physical constants have been determined on the body oils of a number of samples of codfish and of the fish usually substituted for cod, that is, cusk, haddock, hake, and pollock. The body oils give quite different constants from the liver oils and appear to be of a complex nature. In the case of dried fish the oil was much oxidized. This work is being extended to an investigation of the nitrogenous compounds of these fish.

DETERMINATION OF SULPHUROUS ACID IN GELATIN AND OTHER FOOD PRODUCTS.—Various methods of determining sulphurous acid in food products were compared to determine the validity of certain criticisms directed against the official method. The best results were obtained with the Gudeman method.[a] In gelatin and beer the results obtained by this method were in accord with those obtained by the official method. With dried fruits especially the results obtained were much better than those by the official procedure, since the size of the portion used for analysis is not limited and distillation can be carried as far as desired. In the case of molasses, the official method gave high results, due to the formation of iodin-reducing substances necessitating the use of copper-sulphate solution. It is believed as a result of this work that volumetric estimations of sulphurous acid are wholly satisfactory under proper conditions. Gelatin prepared in the laboratory was found to be free from sulphurous acid and to give off no iodin-reducing substances under the conditions of the methods used.

EFFECT OF TEMPERATURE AND CONCENTRATION ON THE SPECIFIC ROTATION OF COMMERCIAL GLUCOSE.—This work was done on pure hydrolized starch products of typical specific rotations and on a number of commercial samples representing the grades of glucose at present on the market. The specific rotation was found to decrease with increased concentration; in many of the samples there was a notable decomposition at temperatures above 85° C. No definite relation was found between the concentration of the glucose and the ratio of its invert polarization at 87° to the direct polarization at 20°, except that this ratio is smaller at the lower concentrations.

BUFFALO LABORATORY.

The 83 samples of imported products examined at the Buffalo laboratory consisted chiefly of distilled and fermented liquors, meat and fish, and oils and fats, and it will be noted that a rather small proportion were illegal, about 20 per cent. Port inspections are made at Rochester, Niagara Falls, and Dunkirk monthly, and oftener if the collector calls attention to a special case. Of the 464 interstate samples examined, about 41 per cent were found to be illegal, the principal classes of foods inspected being dairy products (24 out of 44 samples illegal), flavoring extracts (67 out of 137 samples illegal), saccharine products (37 out of 112 samples illegal), spices and condiments (19 out of 62). The 162 miscellaneous samples reported in the tabulation were taken for study in the elaboration and improvement of methods of analysis.

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[a] J. Ind. Eng. Chem., 1909, 1: 81.

Investigations undertaken during the past year included the examination by chemical and physical methods of 86 samples of canned peas with a view to establishing data from which to distinguish soaked goods from fresh. Some valuable results were obtained which have been of assistance in passing on commercial samples submitted in the course of routine food inspection. The laboratory also conducted investigations of flavoring extracts in testing the colorimetric method for the determination of citral in lemon extract. In addition, a test of the comparative merits of a number of methods for the estimation of benzaldehyde in almond extract is in progress and considerable work has been done on the determination of starch and crude fiber in cocoa products.

CHICAGO LABORATORY.

The samples examined at the Chicago laboratory include, in addition to those collected in the inspection of foreign and domestic goods, various products submitted for examination by the local representatives of the Treasury, Interior, and War Departments, and also by the Council on Pharmacy and Chemistry of the American Medical Association. As this is the only Government laboratory in Chicago equipped for general work, the need of cooperation with other branches of the Government service is obvious.

Considerable time has been devoted to the study of analytical methods and to the analysis of products of known origin, although as yet only two short papers have been published. A method has been developed for the determination of vanillin, coumarin, and the lead number in one weighed portion of vanilla extract, which, it is believed, will facilitate the distinction of true vanilla extract from imitations. Vanilla extracts have also been prepared from a wide variety of vanilla beans of different grades and lengths, representing the product of different countries. The analysis of these extracts will yield valuable data for use in the interpretation of analyses of the commercial product.

Examinations have been made of a large number of samples of flour, both bleached and unbleached, representing the products from different sections of the country. The work included determinations of nitrogen as nitrites and the color values of the petroleum ether extract. Papers on this subject were presented at the Bakers' Institute, held under the auspices of the University Extension Department of the University of Wisconsin, at Milwaukee, October 26–28, 1908.

As several chemists, owing to temporary transfers to other laboratories for special work, have been absent during part of the year the degree of efficiency to be expected under normal conditions could not be attained. Because of the importance of Chicago as a distributing center for groceries, flour, and other food products, the demands made on the laboratory are steadily increasing and the volume of work will be much augmented another year. Reference to the tabulated statement shows that of the 2,057 domestic samples examined 640, or about 31 per cent, were illegal. The principal classes of foods examined were cereal and dairy products, flavoring extracts, saccharine products, oils and fats, and spices and condiments, over 40 per cent of the flavoring extracts being misbranded or adulterated and about 35 per cent of the saccharine products. Of the 321 imported foods examined 142 were found to be illegal—dairy products, distilled liquors, meat and fish, and drugs showing the highest percentages of illegality—more than half of those examined proving to be below the requirements of the law.

CINCINNATI LABORATORY.

The total number of samples analyzed in the Cincinnati laboratory was 1,154, of which number 546 were legal, 518 illegal, and 87 were miscellaneous. Of these, 740 were dairy products, and about 100 samples each of flavoring extracts, saccharine products, and spices and condiments were tested. Of the three latter classes, from 24 to 30 per cent were adjudged illegal.

In regard to the dairy products it should be noted that the milk situation in Cincinnati demanded special attention with reference to the shipment of watered and adulterated milk from Kentucky and Indiana into Cincinnati. When this special investigation was begun in September, 1908, of the samples analyzed about 60 per cent were shown to be adulterated, and this percentage decreased to about 9 or 10 per cent during March and April, 1909. Of the total number of dairy products examined, exactly 50 per cent were found to be illegal. A total of 610 hearings on interstate samples has been held at this laboratory.

The work has been along the general lines of food inspection, very little research work of any kind having been attempted except in the checking of methods used. About one dozen samples were analyzed for the Treasury Department and 18 analyses were made for the Post-Office Department, principally of distilled liquors sold through the mail-order houses in this district.

DENVER LABORATORY.

The proportion of illegal interstate samples examined at the Denver laboratory, as shown in the tabulation, amounts to more than one-third of the total. A large number of these, however, were so classed because of trivial infractions of the law that did not interfere with their being placed in permanent abeyance. By far the most common violation was found to consist in shortage of weight or measure, and, though often small, the shortage in one instance ran as high as 30 per cent. Misbranding by reason of extravagant or false statements was also prevalent, but actual willful adulteration by gross substitution of foreign material, such as was doubtless common before the enforcement of the food law, was found to be extremely rare. Only one case of what might be termed poisonous adulteration was found, namely, an almond extract containing hydrocyanic acid. This case was prosecuted in court.

While in the main the larger dealers in this part of the country seem to be sincere in their expressed support of the food law and are evidently trying to comply with its provisions, some are still apparently ignorant or indifferent as to its bearing on their business, the value of guaranties, and their own responsibility under the law.

Following is a brief abstract of the experimental or research work done:

A simple and convenient colorimetric method was devised and tried out for the determination of citral in lemon extracts and oils by the use of an alcoholic solution of metaphenylene diamin hydrochlorid. Two important advantages of the method are that it may be carried out at room temperature and that it does not require the use of aldehyde-free alcohol. Incidentally the working out of this method has led to an investigation of a certain apparent impurity occasionally found in citrus products, such as oil of lemon and limonene. In view of the issuance by the French Government of regulations forbidding the use of lead, internally or externally, on tin cans used for food products after August 1, 1909, an investigation was made as to the conditions prevailing in French cans for preserving foods prior to the adoption of the regulation. Fifty-eight samples, containing the products of 47 manufacturers, were submitted to examination. In no case was any lead found in the tin plate used. The solder employed on the side seams and ends was almost invariably confined to the outside of the can, and in the rare instances where an appreciable amount of solder was exposed inside the can, it was apparently accidental. The solder varied in lead content between the limits of 45 and 72 per cent, averaging about 60 per cent.

The experimental work has also included a brief investigation of the proper polarizing value to be assigned to the grade of commercial glucose known as " mixing " or " M " glucose, for calculating the percentage of that product present in compound honey, molasses, etc. The main object is to test the accuracy of the formula now commonly used for this purpose. Samples of lemon extract submitted for cooperative work on methods of examination were analyzed and reported.

DETROIT LABORATORY.

Of the 400 interstate samples examined at the Detroit laboratory about one-third were found to be illegal, and of the 66 imports only one-ninth, practically all of which were drugs. The miscellaneous samples, 62 in number, included the examination of butter and fermented and distilled liquors for the internal-revenue collector; also samples of raw peanuts, which were examined for boric acid for the purpose of determining whether this were a normal constituent of peanut butter. Of the 216 hearings conducted at this laboratory the greater number pertained to dairy products, 36; flavoring extracts, 34; saccharine products, 20; vinegars, 22; and drugs, 44.

GALVESTON LABORATORY.

The more important classes of interstate samples examined at the Galveston laboratory included cereal products, flavoring extracts (65 out of 74 found to be illegal), oils and fats, saccharine products (37 out of 51 samples adjudged illegal), and spices and condiments, a total of 189 illegal samples out of the 431 samples examined. Of the 84 imported samples analyzed, 2 were ordered to be reshipped and 28 to be relabeled. The hearings held on 92 interstate and 30 import cases have consisted largely in the former instance in the filing of guaranties and taking evidence of interstate shipment.

In addition to the regular routine work, considerable time has been devoted by the acting chief of the laboratory to collaborative work on methods for the determination of fusel oil and of caramel in whisky, of sodium benzoate in ketchups, and of colors in food products. Some work was also done under the direction of the chief of the Division of Foods on the analysis of oysters, samples of which were taken directly from the reefs and packed under varying known conditions.

HONOLULU LABORATORY.

The report of the Honolulu laboratory represents the work of the chemist in charge, who acts both as analyst and inspector. Of the 209 imported samples analyzed, 107, or about 51 per cent, were found to be illegal, the meat and fish samples and drugs being the worst offenders. The inspection work was confined entirely to imported food and drug products, approximately nine-tenths of the shipments being from China and Japan. As there was no systematic inspection prior to the installation of this laboratory, it was necessary to give considerable time to instructing the importers in the provisions of the law and the regulations.

In connection with the routine inspection of imported products, it became necessary to study somewhat fully some of the peculiar conditions and substances concerned. For example, an inquiry into the manufacture and branding of Chinese liquors was made; an investigation of the Japanese beverage "sake" and the keeping qualities of the nonpreserved article, and the use in Japanese food products of anilin colors.

As Honolulu is the only port in Hawaii through which food and drug products are entered in foreign commerce, there has been no inspection made at the other ports of entry in the Territory.

During the year, 86 hearings were held on illegal imported shipments and 21 shipments were released without prejudice to future decisions.

KANSAS CITY LABORATORY.

The work in the Kansas City laboratory is devoted to interstate samples entirely, and of the 512 examined during the year 126 were adjudged illegal. Of the 259 dairy products analyzed only 37 were found to be adulterated or misbranded, in sharp contrast with the conditions found in Cincinnati. Thirty-six flavoring extracts out of 84 samples were declared illegal, and of the saccharine products 19 out of 44. Of the 258 hearings held at Kansas City the greater number concerned flavoring extracts and saccharine and dairy products.

NASHVILLE LABORATORY.

The Nashville laboratory has just been installed and the chemist in charge reached Nashville on June 10. In addition to the regular work in the enforcement of the food law, considerable time will be spent on a special investigation of methods for the analysis of vinegars.

NEW ORLEANS LABORATORY.

The results of the regular inspection work at the New Orleans laboratory, as reported in the table, show that of 213 imports examined about 56 per cent were found to be illegal, and of the 388 domestic samples about 37 per cent were either misbranded or adulterated. The more important classes of materials examined included dairy products, flavoring extracts, saccharine products (32 out of 98 samples found to be illegal), and spices and condiments.

Apart from the regular inspection work, 113 unofficial samples were examined. These included an examination of foods offered to the Purchasing Commissary for use in the Army, and resulted in many instances of rejection of the supply offered. Food samples taken by the inspector from the public institutions in the State, such as the charity hospital, Confederate soldiers' home, State insane asylum, and the State penitentiary were also analyzed. Some chemical work was done for the grain standards laboratory, in connection with the board of trade, to aid in the selection of a suitable seed corn for use in experimental corn growing in Louisiana.

Research work done covered the following points: (1) In the determination of heavy metals in molasses considerable trouble was experienced, especially in the determination of zinc and tin. After some work, certain modifications were applied to the official method, which largely obviated this difficulty. (2) Some preliminary work has also been done to devise, if possible, a method for the detection of mixtures of small quantities of corn oil with cotton-seed oil.

NEW YORK LABORATORY.

New York being the principal port for the entry of foreign products into this country, the work of that laboratory is confined largely to the inspection and analysis of imported food and drug products. This inspection has been carried on for about five years, and has caused marked changes both in the character of the goods shipped to this country and in the manner in which they are labeled; particularly is this true of those products which have been fully investigated and thoroughly covered by the inspection. Investigations as to the character and the composition of the various products that are presented for entry are constantly being made, and in many instances have already resulted in fixing standards for purity and comparison whereby entry has been denied inferior and refuse products.

The inspection of crude drugs, begun at this laboratory two years ago, has yielded especially marked results during the past year. Practically all shipments of the ordinary crude drugs imported into this country have been subjected to both a chemical and a microscopical examination, with the result that a great many have been rejected because of adulteration or low quality, and a much better grade of products is now being presented for entry. This inspection has brought to light numerous products of which there is little or no knowledge as to the composition or character. These are being studied to determine their composition and methods of identification.

During the past year 52 samples of oils were received for analysis for certification for the export trade. The largest classes of imports analyzed were drugs (1,090 samples, of which 45 per cent were misbranded or adulterated) and dairy products (1,475 samples, of which about 42 per cent were illegal). In other cases, however, the percentage of illegal samples was much lower, only 73 out of 351 spices and condiments falling below the requirements, 28 out of 215 cereal products, and 39 out of 133 vegetables. The meat and fish samples and the fermented and distilled liquors, however, again show a high percentage of illegal shipments, 47, 52, and 61 per cent, respectively. Over 44,000 floor inspections were made for the purpose of passing on the labels, methods of packing, etc., to aid in the judicious selection of samples for analyses. The percentages of adulteration and misbranding given, therefore, in nowise represent the condition of the trade as a whole, only suspected samples being examined.

Aside from the samples taken by the two local inspectors and the check samples from other laboratories, the work on domestic products at the New York laboratory was largely confined to vinegar. Of the 740 interstate samples examined, 543 were vinegars, of which about one-half were found to be illegal.

Another important line of work pursued has been the chemical control of the colors for food products submitted for certification under the provisions of Food Inspection Decision No. 77. In all, 53 samples of colors were received for certification, each of which was submitted to a complete chemical analysis and to certain physical tests necessary to determine their purity. This work has necessitated the study of existing methods of color analysis, and has resulted in at least two instances in the development of new methods, one for the determination of iodin in erythrosin and the other for the detection of Orange II in Orange I.

One of the most important products studied during the past year is coffee. Several shipments of so-called " Black Jack " and " Triage " have been refused entry. Type samples of both the roasted and unroasted beans of the various varieties of coffee have been secured for comparative purposes. Many samples of roasted coffees have been received for identification, the laboratory securing the services of a coffee expert for this branch of the work.

Another important line of work is the examination of the food supplies for the Isthmian Canal Commission. During the past year this work has been extended at the request of the Secretary of War to cover drugs and medical supplies, including in all about 500 samples.

A few samples of patent and proprietary medicines have been examined for the Post-Office Department in connection with the issuing of fraud orders, and material assistance has also been rendered to the Treasury Department in the analysis of samples and the presentation of cases before the Board of General Appraisers and in the courts in connection with the levying of duties on olive oils.

In addition to those already specifically mentioned, the following studies have been undertaken to provide new methods of analysis or improve those in use, all being necessitated by the exigencies of the inspection work: Comparison of the Allen-Marquardt and titration methods for determination of fusel oil in liquors; detection of added oil in paprika; the separation of the essential oil of balsam copaiba and a study of its resin; analysis of Peru and Tolu balsams, styrax, and gum benzoin; analysis of wintergreen oil; determination of small quantities of lime in magnesium oxid; standards for saffron and gentian, and the quantitative determination of morphin in galenicals, particularly in the presence of glycerin and sugar.

OMAHA LABORATORY.

The Omaha laboratory has been in active operation only six months. The examination of official samples is confined almost entirely to domestic goods, and 130 hearings have been conducted in connection with the interstate inspection work, 261 samples having been analyzed. Retail dealers generally produced a satisfactory guaranty from the jobbers or manufacturers, who in every instance desired to assume responsibility for the violations and seemed to be entirely in sympathy with the law. The violations appeared to be largely the result of ignorance or oversight, and there is evidently a uniform and sincere desire to correct existing faults whenever they are brought to light.

Thirty-eight miscellaneous samples have been examined for the local internal-revenue office of the Treasury Department. These included samples of wines, cordials, and alleged nonalcoholic beverages (determination of alcohol), butter (for the determination of moisture), and oleomargarin (for added color), on all of which a prompt preliminary test was desired and obtained without the loss of time which would have resulted in transmitting the samples to the Treasury laboratory at Washington.

Research work on methods for the determination of benzoic acid in ketchup has been conducted, and considerable time was spent on the estimation of the maple content of mixed sirups made from maple and cane sugar sirups; as an aid in this estimation a modified Winton lead number has been proposed and found useful.

PHILADELPHIA LABORATORY.

The more complicated character of the foods examined during the past year at the Philadelphia laboratory and the increased amount of executive work required on interstate products, together with a decrease in the force, have somewhat limited the number of samples examined. As shown by the tabulation, the inspection of imported goods has constituted the principal feature of the work, and about 24 per cent of the 685 importations examined were found to be illegal. Over 6,000 floor inspections were also made; drugs, oils, fats, and fermented and distilled liquors receiving special attention. The principal classes of domestic food examined were cereal products, coffee and cocoa, flavoring extracts, oils and fats, saccharine products, and spices and condiments, about 40 per cent of the 216 domestic samples analyzed being found illegal. In this connection it is only fair to state that many apparent violations of the law are due to not thoroughly understanding its requirements, and at the 200 hearings held in connection with these, in many cases the manufacturers and importers voluntarily made the necessary changes either in the composition of the formula of the product or in its label, when the matter was called to their attention.

Research work on methods of analysis has been conducted along the following lines: Determination of benzoic acid in ketchup, estimation of citral in lemon oil and extracts, determination of ether extract in paprika, identification of coloring matters, determination of sucrose, lactose, and crude fiber in cocoa products, and the estimation of fusel oil in whisky.

PITTSBURG LABORATORY.

The Pittsburg laboratory has been in operation about seven months. The work of installation was begun in August and completed in November, 1908, an assistant chemist reporting for duty soon afterwards.

Practically all of the time has been devoted to the regular routine work of examining imported and interstate samples. A method for the determination of sugar in chocolate, which materially shortens the time of analysis, has been worked out, and a rapid method for the determination of fat in cocoa and chocolate is being elaborated in connection with the examination of samples of this character.

The import work has resulted in the examination of 51 samples, 21 of which were illegal. These samples were misbranded along certain general lines, and most of the labels have since been corrected. Of 66 interstate samples of flavoring extracts 50 per cent were found to be illegal, and of 38 fruit products 23 were contrary to law, as were one-third of the 27 samples of saccharine products analyzed.

One hundred and fifty-seven hearings on domestic samples have been held. In the greater number of cases the manufacturers have since corrected their labels and others have taken advantage of the proximity of the laboratory to ask for information regarding the labeling of their products.

PORTLAND LABORATORY.

Of the 220 imported samples analyzed at the Portland laboratory one-third were found to be illegal, and of 206 domestic or interstate samples analyzed nearly 29 per cent were adjudged misbranded or adulterated. In addition to the routine work of the laboratory, 82 miscellaneous samples were examined, as follows: For the Treasury Department at Portland, 27 examinations of silk and cotton cloth, sugar, and pineapple; for the War Department (commissary of subsistence) at Vancouver, Wash., 9 analyses, including flavoring extracts, baking powder, olive oil, spices, and butter; in cooperation with investigations in the food division of the Bureau of Chemistry, 33 analyses were made of ketchup (for benzoic acid), oysters, and whisky. The remaining samples were check analyses on interstate work. Five standard extracts (U. S. P.) have also been prepared from imported vanilla beans to be used for comparison and study.

As a result of the examination of imported samples 72 hearings have been called, and, in addition, 76 hearings on interstate samples have been held. All show a desire to comply with the law, and cases of adulteration and misbranding have been due more to carelessness or ignorance than to any willful intent.

ST. LOUIS LABORATORY.

The St. Louis laboratory was installed and in working order on January 1, 1909; the acting chief took charge on that date and an assistant chemist was assigned during May. The work reported therefore covers a period of only six months, and the greater part of the time was devoted to hearings, 391 having been held. Of the 283 interstate samples examined over one-third were adjudged illegal, including 26 out of 67 saccharine products, 29 out of 50 flavoring extracts, and 14 out of 23 cereal products. The 48 miscellaneous samples reported were food products examined for the local purchasing department of the United States Army, only one sample being found to be below the requirements.

ST. PAUL LABORATORY.

At the St. Paul laboratory the investigations on the extraction and estimation of the higher alcohols in distilled liquors, begun during the last fiscal year, were completed.

While the baking tests on cereal products were necessarily discontinued, owing to the transfer of the baking expert, the chemical investigation of cereal products has been continued, especially in regard to the bleaching of flour and its effects.

Much of the time of the chief of laboratory was necessarily occupied with hearings on interstate cases. With a few marked exceptions the evidence has shown entire willingness on the part of the manufacturers and jobbers of food products to comply with the law. It was developed at these hearings that the practice of adulterating rye flour with low-grade wheat products in amounts varying from 20 to 60 per cent and the sale of the same under the caption "Family Rye Flour" was quite prevalent. It is believed that the millers have come to see this offense in its true light, and in this vicinity the practice is largely discontinued. Saccharine products and spices and condiments were the principal classes of interstate goods examined, the former showing 26 per cent of illegal samples and the latter 46 per cent. Of the 51 flavoring extracts only 8, or about 15 per cent, were adjudged illegal.

Work at this laboratory has been further curtailed during the past year by the transfer of two chemists to the Galveston laboratory and the detail of another to Washington. The inspection of imports at St. Paul and Minneapolis has caused the detention and rebranding of skim cheeses, with the result that recent shipments from Norway and Holland have been plainly branded, as to their quality, when received. Other cases of misbranding as to weight have been corrected by label.

It also developed that clove stems are brought into this country in large quantities to be ground with cloves as an adulterant; one instance of a 20 per cent adulteration of this kind was found. The importations in question were disposed of locally and no evidence of interstate shipment was obtained. It is hoped that a way may be found to exclude from entry such products as are used solely for the fraudulent adulteration of foods and drugs. An effort has been made to extend port inspection by correspondence to Duluth.

SAN FRANCISCO LABORATORY.

A study has been made of the Chinese drugs entered at the port of San Francisco with a view to classifying them under the United States Pharmacopœia. The bulk of these importations are drugs of distinctive Chinese origin and use. Their identification is at times very difficult, owing to the meager information that is available in the Chinese Herb Book and the difficulty of translation when information is obtainable only by word of mouth from Chinese physicians.

Some collaborative work has been done on methods of analysis of citral in lemon extract, fusel oil in whisky, benzoic acid in ketchup, and in the analysis of oysters taken from San Francisco Bay. From time to time studies have been made of special methods of analysis of various foods with a view to expediting inspection work.

In the routine of inspection 1,289 samples of imported and domestic foods and drugs were examined. The more important classes of imported products include distilled liquors (73 out of 97 samples found illegal), fermented liquors (14 out of 37 samples), meat and fish (108 out of 173 samples), dairy products (27 out of 57), and oils and fats (25 out of 47 samples illegal). Of the domestic goods, out of 50 samples of cereal products 50 per cent were illegal; of 57 flavoring extracts, 63 per cent; of 134 saccharine products, about 39 per cent, and of 69 spices and condiments 20 per cent were found wanting.

The administrative feature of the work of this laboratory covers about equal quantities of imported and domestic foods and drugs. In the case both of imported and interstate foods the violations consist mainly in misbranding. It appears that foreign manufacturers will continue to be negligent just as long as merchandise is allowed to be relabeled after reaching this country, though in the main misbranding is corrected when it is specifically called to their attention. At this port all European goods are bought subject to sight draft on arrival, and the importer has no redress if the importation does not conform to the requirements. A more rigorous enforcement of the law by reshipping misbranded merchandise would have a very beneficial effect on the labeling of products offered for entry.

The greater number of the 163 hearings on interstate products also consisted of misbranding violations. From the statements made by the parties cited it appears that the violations were due to misunderstanding the law or to neglect in obtaining information regarding it. Some were due to unavoidable accidents and few, if any, were the result of deliberate intent. In only a few cases have the manufacturers felt that the analyses made by the Department have been in error and results of their investigations have confirmed the findings of the Department in every case. The hearings have at all times been marked by a spirit of cooperation on the part of the manufacturers and a willingness to meet the policy of the Department more than half way.

·The general effect of the Food and Drugs Act on the manufacture and marketing of food products which are distinctly Californian in character has been excellent. The production of "quality" products has been augmented and their increased appearance on the market has been accentuated by the decline in the production of inferior goods. This is particularly true of California wines, brandies, olive oils, honey, and fruit products, although this effect extends in some instances to products not distinctive of the State, several manufacturers having declared their intention to pack no more cheap products since first-quality goods no longer have to compete with inferior grades. This condition has been brought about by the rigorous enforcement of the California State laws, as well as by the enforcement of the Food and Drugs Act.

SAVANNAH LABORATORY.

The work of the Savannah laboratory for the past year has been devoted largely to the analysis of interstate samples, there having been only a small amount of imported foods entered at this port, as is shown in the tabulated statement. The miscellaneous samples represent for the most part collaborative work on methods for the examination of whisky, flavoring extracts, and preservatives. About 42 per cent of the 356 interstate samples examined were considered illegal.

SEATTLE LABORATORY.

The work of inspection of imported foods and drugs at the Seattle laboratory has shown an increasing effort on the part of the importers to comply with the law, and in most cases the trouble is apparently due to the indifference of the shippers abroad. Considerable attention has been given to Japanese drug products and to the coating of oriental rice with a mineral matter which appears to be a siliceous earth used in removing the outer hull and coatings of the uncleaned rice.

About half of the 33 domestic samples of flavoring extracts examined were found to be illegal and nearly one-third of the 66 samples of saccharine products. Of the imported samples, 22 out of 38 drugs were declared illegal, 18 out of 40 dairy products, 11 out of 28 fermented liquors, 27 out of 82 samples of meat and fish, and 12 out of 42 cereal products. This brief summary of the more important classes of products examined serves to give some idea of the tendencies disclosed by the inspection and of the need of the work. As shown in the summary table, 298 imported products were declared legal and 124 illegal, while of the interstate samples 130 were found to be according to the law and 64 illegal.

Of the 83 hearings on domestic products held in this laboratory, about half were on flavoring extracts and saccharine products and presented no points of special interest.

This laboratory has also analyzed 48 samples of food supplies for the War and Navy Departments and examined 70 samples of miscellaneous imports for the Customs Division of the Treasury Department, to aid in making the proper classifications.

THE NEW BUILDING.

Since the enactment of the Food and Drugs Act of June 30, 1906, the work of the Bureau of Chemistry in Washington has been greatly augmented, and the space occupied has increased from one building to eight. Many of these buildings are small and poorly adapted to the purpose for which they are used, and their remoteness from each other has greatly handicapped the Bureau in its work.

During the last year a new building, to accommodate the entire Bureau situated in Washington, has been constructed and is now being equipped. The building is of reenforced concrete construction and contains six floors and basement, with a total floor space of about 63,000 square feet.

PUBLICATIONS.

During the past fiscal year 15 bulletins have been prepared, 13 of which have been published; 17 publications in circular form, including four Yearbook articles and the Report of the Chemist; 11 food inspection decisions and 79 notices of judgment, aggregating in all 1,765 pages of original matter.

The orders for job printing totaled 302, consisting principally of index cards and forms, circular letters, and stationery; 237 requests were drawn on the photographic laboratory of the Division of Publications, of which 133 were requests for drawings, a great deal of expert drafting having been done in that section for the Bureau in the drawing up of plans and specifications for the port laboratories and for the new laboratory building at Washington, D. C.

SUPPLIES AND CLERICAL WORK.

The plan of distributing supplies to the branch laboratories from a central storeroom in Washington, inaugurated during the preceding year, was carried out with considerable advantage. All chemicals and apparatus are systematically tested and passed on by the Contracts Laboratory or Drug Division before being accepted, thus insuring a high and uniform grade, very essential for accurate analytical work.

The clerical work on the records and the correspondence in connection with the interstate cases under the Food and Drugs Act has been greatly increased. This work is intricate and has to be done with dispatch and accuracy.

WORK OUTLINED FOR THE FISCAL YEARS 1910 AND 1911.

OFFICE OF THE CHIEF INSPECTOR.

The greater portion of the fiscal year 1910 will be devoted to the collection of official samples of food and drug products for examination and to the inspection of manufacturing establishments, with the view of observing the character of raw materials which enter into the composition of food and drugs and whether the same are prepared under sanitary conditions and among unobjectionable surroundings. In addition, it will be necessary to take up for special investigation such questions as are referred by the various laboratories, and also problems which arise through reference for prosecution in cases of violation of the law where additional information is necessary.

Investigations already begun will be continued to probe into the practice of shipping citrus fruit in an immature state to markets where the same is subjected to chemical or other artificial treatment to give it the appearance of fruit ripened by natural process.

The investigations, which have been made for some time, to locate interstate shipments of flour which has been bleached with peroxid of nitrogen will also be continued.

The practice of marketing fish which are incorrectly branded as to variety or origin is now the subject of an investigation which will be further carried on to suppress this illegal trade custom.

The use in foods of eggs or egg products which are unfit for consumption because of the unwholesome character of raw materials from which prepared, or the insanitary conditions under which manufactured, will be investigated, and wherever violations are discovered steps will be taken to have the same prosecuted.

In addition to the above, investigations will be continued to suppress illegal traffic in adulterated or misbranded wines, liquors, coffees, stock feeds, milk, vinegars, and waters.

DIVISION OF FOODS.

The investigations in the chemistry, physiology, and technology of fruits will be continued with a view to increasing our knowledge of the nature and composition of this class of products and of studying and preparing new forms for their preservation and preparation for the market.

The study of the influence of receptacles on the character and composition of foods will be continued. It is important that full information be obtained as to the relative value of materials used in the preparation of such receptacles for foods of different types, leading to their improvement.

It is proposed to continue such examinations of foods as may be desired by the Commissary Department of the Army and the Pay Department of the Navy for the purpose of assisting in the preparation of specifications and determining whether the deliveries made are in accordance with them.

The work in the Washington Food Inspection Laboratory will be a continuation of the special work for which the laboratory was established; that is, the checking of results, and the examination of regular food inspection samples of this locality. In addition, the study of the maturing of whisky, begun a year ago, will be continued, as well as the study of methods of analysis for distilled spirits, and especially of the quantitative separation of the coloring matter present.

Special attention will be given to the study of the composition of cider vinegar, methods of analysis, and the detection of adulterants.

Further work will be done toward the unifying of the methods or reporting analyses in the various laboratories; and the work of bringing about some international agreement as to the methods of analysis to be applied to American fats and oils in foreign countries will be continued.

In the Oil, Fat, and Wax Laboratory, which has just been established, a further study of the oils, fats, and waxes commonly used with foods will be made, with a view to obtaining more specific information regarding them and to improving the methods used in their examination.

For the ensuing year it is proposed to finish the investigations on lemon oil in the Food Technology Laboratory and to offer for publication a report on this subject. In addition to this, vanilla and other extracts will be studied more fully. A large amount of time will also be given to consideration of problems presented by the California by-product work.

DIVISION OF DRUGS.

The Drug Inspection Laboratory, as heretofore, will examine domestic drugs, check analyses of imported drugs not provided for by the special laboratories, and keep systematic records of domestic and imported drugs required for the handling of cases. Special investigation of certain drug products imported into the United States which may be dangerous to the health of the people will be continued, such as the investigation of products containing habit-forming drugs. In this connection particular attention will be given to the improvement of methods of analysis, such as the detection and determination quantitatively of the various alkaloids and other plant constituents contained in the complex mixtures on the market.

The activities of the Synthetic Products Laboratory will cover, as in the past, the examination of imported and interstate samples involving ingredients of a synthetic character.

In the Pharmacological Laboratory the investigation with regard to the influence of caffein and caffein products on metabolism will be continued, and, in addition, studies relative to the chronic toxicity of this drug will be made, as well as to the extent to which one drug may counteract the undesirable effects of another. To the investigation of the poisonous effects of amyl and ethyl alcohols will be added studies with regard to the toxicity of other alcohols and aldehydes. Physiological tests of drug products for the purpose of determining their activity and usefulness and the elaboration of methods to confirm physiologically the presence of certain medicinal ingredients when indicated by chemical analysis will be continued. The present methods of analysis in connection with the studies of animal metabolism will be further exploited with a view to their improvement.

The Essential Oils Laboratory will investigate essential oils and products in the manufacture of which the same are used. This work will include the study of the Pharmacopœia standards for essential oils and the variability of genuine oils. The chemical and physical properties of oils of different origin and produced under different conditions will be compared, and the character and extent of any adulteration found will be investigated. In addition to the study of oil of peppermint, which is now in progress, oil of gaultheria will be investigated. In cooperation with the Bureau of Entomology, the study of the constants of pure beeswax, obtained from various parts of the world, will be extended through the fiscal years 1910 and 1911. The investigation of so-called "soft drinks" which contain ingredients that may be deleterious to health and domestic products containing habit-forming drugs will also be continued.

MISCELLANEOUS DIVISION.

The mineral water survey of the United States which was begun in 1904 will be continued and the portion of the work so far completed will be prepared for publication. The examination of bottled mineral and table waters found on the market, for the purpose of securing data for the proper enforcement of the Food and Drugs Act, will be continued, as will also the examination of the water supplies of cities and towns when the exigencies of the public service demand the same. Improved methods of analysis for mineral waters and the radio-activity of certain mineral springs will be studied.

Work on methods will include especially those for the analyses of insecticides and the determination of soluble arsenic in the same.

The composition of cattle and poultry foods and remedies as they appear on the market will be examined in relation to the proper enforcement of the Food and Drugs Act, and the study of range forage crops will be continued in cooperation with the Bureau of Plant Industry. The investigations already under way on the feeding value, commercial importance, and adaptability of grains will be extended so as to include studies on the milling and baking quality of cereals and other products and the effect of bleaching on flour.

The composition of lead arsenate as well as the impurities contained by certain insecticides, notably commercial lead arsenates, and the injury to foliage caused by them will be further studied. The supposed damage to fruit trees from the accumulation of toxic salts in the soil, due to the use of excessive amounts of insecticides, will be investigated in cooperation with the Bureau of Entomology. The study of arsenic and other poisons in fabrics, wall papers, and other household articles will be continued, as will also the arsenic content of certain fruits and foods. The effect of toxic gases on different species of plants, and also the resistance of certain plants to copper, arsenic, and other smelter wastes will continue to be investigated, and field observations on certain regions in the vicinity of smelters will be made.

It is also proposed to make an examination of the atmosphere of schools, public buildings, railroad cars, etc., to determine the effect of polluted air on the comfort and health of the occupants, and in connection therewith of the method of manufacture and practical value of disinfectants.

SUGAR LABORATORY.

The plans of work for the fiscal year 1910 are in large part a continuation of the investigations already described, in so far as they have not been finished, and may be outlined as follows:

(1) Analyses of authentic samples of honey coming from various countries.

(2) A completion of the analysis of samples of maple sirup and sugar already collected, and field work during the coming season, to elucidate some of the points so far brought out by the analyses.

(3) As the time allows, it is the intention to investigate sorghum sirup and molasses with much thoroughness, collecting samples of pure products and determining their characteristics and chemical composition so as to distinguish the pure from the adulterated article.

(4) A study will be made of the chemical composition of cane sirup and molasses, both made by vacuum and open-kettle processes.

(5) A study of methods of determining the per cent of sugar in the beet.

(6) A study of the methods of analysis used for determining sugar in various factory products.

(7) A continuation of the general work on chemical methods employed in the analysis of sugars and carbohydrates.

(8) A continuation of the work on the effect of environment on sugar-containing plants.

DAIRY LABORATORY.

Besides the routine work, the plans of investigation of the Dairy Laboratory are as follows:

(1) The study of the process of condensing milk to determine the practical limit of condensation consistent with a good mechanical condition.

(2) The study of the composition of cows' milk produced in the States of Washington and Oregon, as compared with that produced in other sections of the country.

(3) Work on the perfecting of analytical methods, and the checking of analyses received from the branch laboratories.

LEATHER AND PAPER LABORATORY.

The testing of paper, leather, and turpentine for other Departments which request such tests will be continued with especial reference to the qualities that determine value in service. Experiments on the quality of papers to be used for various special purposes will be conducted, and investigations of new paper-making materials and paper-making processes will be made. Under the Food and Drugs Act turpentine will be examined, and the proper methods of differentiating commercial turpentine will be studied. Work will be continued on the production and utilization of the products of the destructive distillation of wood, and also on the study of native American tanning materials.

CONTRACTS LABORATORY.

The work of the Contracts Laboratory for the fiscal year 1910 is planned along the same lines as that of the year preceding, as much time as possible being given to the study of paints and paint materials, especially the examination of linseed oil and service tests of paints made in cooperation with the American Society for Testing Materials, which work will probably be continued during the fiscal year 1911. It is also proposed to continue the study of methods for the analysis of alloys, and in cooperation with the Treasury Department and the technological branch of the Geological Survey to make a study of the inflammability of denatured alcohol and of methods for the storage of the same.

The preparation and improvement of specifications for the purchase of materials for the Executive Departments and independent establishments of the Government will be undertaken in so far as the very rapidly increasing amount of work requested by other branches of the Government, which keeps the laboratory force fully occupied with routine work during the greater part of the year, will allow. The increasing number of requests from the General Supply Committee, the Isthmian Canal Commission, and the Bureau of Engraving and Printing for the examination of supplies are the principal items which will augment the routine work of the ensuing year.

MICROCHEMICAL LABORATORY.

In addition to the regular routine work in collaboration with the other laboratories of the Bureau, the following microscopical investigations are to be continued by the Microchemical Laboratory: (1) Examination of cold-storage, liquid, and desiccated eggs; (2) analytical methods for the identification of alkaloids; (3) histological studies of small fruits, drugs, and mustards.

FOOD RESEARCH LABORATORY.

The proposed work of the Food Research Laboratory for the fiscal year 1910 will consist chiefly of the study of poultry and eggs. Certain of the industrial problems relating to the handling of these products will be studied (1) in the field by investigations conducted in the packing houses during transportation as well as in the warehouses and after the produce has reached the hands of the commission merchant or the retailer; and (2) in the laboratory, where by anatomical, histological, bacteriological, and chemical study the elucidation of the problems will be sought by scientific means. The results so acquired will then be applied practically in the industry for the betterment of the produce on the market, and the data collected will form a contribution to the scientific knowledge of putridity and decomposition.

SPECIAL INVESTIGATIONS.

ANIMAL PHYSIOLOGICAL CHEMISTRY.

The work as planned is a continuation of the work now in progress and falls into two divisions: (1) Metabolism experiments and related food work, and (2) the study of enzyms, especially their relation to ordinary and special analytical methods.

VEGETABLE PHYSIOLOGICAL CHEMISTRY.

For 1910 and 1911 it is intended to continue the lines of work in course of progress and to take up more in detail the following:

(*a*) The study of the influence of climate, soil, etc., on the composition, character, and value of the final product in the case of wheat grown under different conditions, a study of the baking value of the flour being made, and likewise, in the case of durum wheats, of its value for macaroni production. An investigation of the baking value of flours will be undertaken in collaboration with the yeast-culture expert of the Bureau, bread being made with pure yeast of different varieties. This will not only be a study of the flour, but of the quality of the yeast as well.

(*b*) The study of the food value of the high phosphorus-containing portion of wheat.

BACTERIOLOGICAL CHEMISTRY.

The projects for the year 1910 include a continuation of the work already begun on the contamination of shellfish from sewage-polluted sources; the examination of dairy products, such as milk, cream, ice cream, condensed and evaporated milk, milk powders, and infant foods; the testing of the germicidal and antiseptic value of various chemical substances recommended for use in destroying germ life; the testing of the sterility of dressings, ligatures, gauzes, bandages, etc., used in medical and surgical practice; and the bacteriological examination of waters from various sources, consisting largely of bottled mineral waters. New lines of investigation will consist of the examination of desiccated, liquid, and frozen eggs and egg compounds, used largely by bakers and confectioners; the examination of edible gelatin, macaroni, manufactured and natural ice; a study of the flora of dried fruits prepared or kept under insanitary conditions; a consideration of the bacterial content of raw vegetables, such as watercress, lettuce, celery, etc.; and the part played by the "typhoid fly" in the transmission of disease-producing organisms. A systematic effort is made at all times to inspect as many localities as possible where food materials are prepared, handled, or stored, in order to note the sanitary condition of such establishments and to observe commercial practices.

ENOLOGICAL CHEMISTRY.

The plans for the work of the fiscal years 1910 and 1911 are in large part a continuation of investigations now under way:

(1) The study of the character and composition of the grape crop as delivered to the wineries and fruit-juice factories of the Lake Erie district, including, in so far as possible, the entire northern grape belt of Ohio, Pennsylvania, and New York.

(2) The collection, organoleptic testing, and chemical examination of the native wines made in the district mentioned.

(3) The preparation of native wines from pure must of the grapes grown in this same district.

(4) A similar line of studies and chemical examinations of apples grown in the northern fruit belt of the United States, and the by-products therefrom.

(5) The study of pure yeast races.

(6) The experiments on the technic of wine making, including an investigation of all the fundamental questions of cellar practice in the fermenting, maturing, aging, and preserving of wines.

REPORT OF THE CHIEF OF THE BUREAU OF SOILS.

U. S. Department of Agriculture,
Bureau of Soils,
Washington, D. C., November 26, 1909.

Sir: I have the honor to transmit herewith a report covering the operations of the Bureau of Soils for the fiscal year ended June 30, 1909.

Respectfully,
Milton Whitney,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PROGRESS OF THE SOIL SURVEY.

THE YEAR'S WORK.

During the fiscal year ended June 30, 1909, detailed soil-survey work was completed or begun in 47 different areas located in 20 different States. In 5 of these States the soil survey was conducted in cooperation with state authorities, who contributed either men or funds, or both, to aid in the prosecution of the work. This cooperation work is discussed more fully in subsequent pages. The soil surveys were assigned in the cooperating States after consultation with the state authorities interested and distributed so far as possible to meet the urgent agricultural needs of the State as expressed by these authorities. The same general plan was followed in the distribution of soil-survey work in the remaining 15 States, and in many instances the desires of the local agricultural authorities were consulted before any assignment of work was made.

During the fiscal year a total area of 24,436 square miles was covered by detailed soil surveys at an average expense of $3.20 a square mile, or exactly one-half cent per acre. This area is 6,605 square miles in excess of the amount covered in the preceding year and the cost of the work was at the same time reduced by 38 cents per square mile.

In addition to detailed soil-survey work, the Bureau of Soils has conducted reconnoissance soil surveys in the Great Plains section and in the Appalachian section of the United States. In these two regions a total area of 76,180 square miles was covered during the fiscal year at an average cost for all localities of 39 cents per square mile. These surveys have resulted in small-scale maps, upon which are represented the more important facts in regard to the character of the soils, the percentage of land available for agricultural purposes, and those other facts necessary for the guidance of settlers in the location of new homes.

In the Great Plains section a total area of 66,052 square miles was covered by the reconnoissance soil surveys during the fiscal year. The western half of the State of North Dakota, or that part west of the one hundredth meridian, constituted one area of 39,240 square miles. The southern counties of Texas lying between the Rio Grande and the Gulf of Mexico formed a second project, and 11 counties in the ''Panhandle'' region of the State a third, the two comprising a total area of 26,812 square miles.

In the Appalachian region an area of 10,128 square miles was covered by a reconnoissance survey in the central and western portion of Pennsylvania.

The total expenditure for the field work of the reconnoissance surveys amounted to $29,639.61, and the average cost for the entire area of 76,180 square miles was 39 cents per square mile.

The following tables give in detail the salient facts connected with the soil-survey work for the fiscal year just ended:

Individual areas surveyed and mapped and cost of field work during the fiscal year ended June 30, 1909.[a]

State.	Area.	Area surveyed.	Cost per square mile.	Total cost.
		Sq. miles.	*Dollars.*	*Dollars.*
Alabama	Baldwin County	[b] [c] 400	4.16	[d] 1,662.04
	Bibb County	[b] 110	1.77	194.56
	Calhoun County	621	3.24	[e] 2,009.71
	Coffee County	261	5.57	[f] 1,453.56
	Colbert County	600	3.96	2,373.46
	Cullman County	741	2.67	[g] 1,981.19
	Etowah County	533	3.49	[h] 1,861.45
	Hale County	576	3.39	[i] 1,955.45
	Jefferson County	1,124	1.82	[j] 2,043.13
	Tallapoosa County	585	2.59	[k] 1,517.28
California	Yolo County	990	5.41	5,358.17
	Yuba-Sutter area	735	6.32	4,642.29
Florida	Marianna area	500	6.41	3,205.72
Georgia	Hancock County	530	1.44	763.19
	Pike County	294	6.10	1,791.94
	Tift County	270	3.94	1,064.74
Indiana	Allen County	667	2.49	1,661.54
Louisiana	Lincoln Parish	510	4.66	2,377.66
Maine	Aroostook area	525	2.97	1,557.93
Maryland	Anne Arundel County	155	4.12	639.02
Michigan	Wexford County	572	.98	558.19
Mississippi	Clay County	411	3.35	1,377.49
	Scranton area	470	3.23	1,520.23
Missouri	Bates County	866	2.58	2,238.30
New York	Livingston County	629	3.77	[l] 2,370.51
	Montgomery County	405	3.56	[m] 1,442.67
	Washington County	305	2.39	[n] 729.30
North Carolina	Caswell County	406	4.60	[o] 1,865.76
	Lake Mattamuskeet area	176	2.16	380.25
	Pitt County	650	2.59	[p] 1,680.72
	Scotland County	100	3.90	390.41

[a] This includes the salaries of the men while in the area and their subsistence expenses, but not cost of transportation to and from the area.

[b] These figures do not include portions of these areas surveyed in preceding years.

[c] Owing to miscalculation of the area surveyed in the 1908 report, and again in the spring of 1909, 400 square miles are reported herein, whereas the actual figures from weekly reports would indicate 312.

[d] Of this amount $733.89 was paid by the State of Alabama.

[e] Of this amount $959.48 was paid by the State of Alabama.

[f] Of this amount $589.91 was paid by the State of Alabama.

[g] Of this amount $1,011.66 was paid by the State of Alabama.

[h] Of this amount $990.13 was paid by the State of Alabama.

[i] Of this amount $708.10 was paid by the State of Alabama.

[j] Of this amount $885.44 was paid by the State of Alabama.

[k] Of this amount $693.94 was paid by the State of Alabama.

[l] Of this amount $853.55 was paid by the New York State College of Agriculture.

[m] Of this amount $520.43 was paid by the New York State College of Agriculture.

[n] Of this amount $198 was paid by the New York State College of Agriculture.

[o] Of this amount $392.46 was paid by the North Carolina department of agriculture.

[p] Of this amount $480 was paid by the North Carolina department of agriculture.

Individual areas surveyed and mapped and cost of field work during the fiscal year ended June 30, 1909—Continued.

State.	Area.	Area surveyed.	Cost per square mile.	Total cost.
		Sq. miles.	*Dollars.*	*Dollars.*
North Dakota	Richland County	1,453	2.46	[a]3,573.20
Oregon	Klamath reclamation project	249	6.32	1,572.81
Pennsylvania	Berks County	120	2.46	294.87
	Center County	[b]833	2.57	2,144.06
South Carolina	Anderson County	756	1.89	1,428.04
	Conway area	500	3.62	1,809.10
	Saluda County	438	1.40	614.08
Tennessee	Coffee County	442	2.44	1,078.63
	Overton County	433	1.77	765.67
	Sumner County	520	2.62	1,364.15
Texas	Camp County	202	6.09	1,229.45
	Grayson County	1,012	3.91	3,960.98
	Morris County	278	2.59	719.30
	Titus County	421	2.90	1,220.09
West Virginia	Parkersburg area	[b]813	1.54	[c]1,255.34
	Spencer area	249	1.90	[d]473.30
	Total	24,436	3.20	78,170.93

RECONNOISSANCE.

State.	Area.	Area surveyed.	Cost per square mile.	Total cost.
North Dakota	Western section	39,240	0.27	10,462.97
Pennsylvania	Northwest section	8,112	.33	2,689.29
	Southwest section	2,016	.37	738.12
Texas	Southern section	16,812	.68	11,504.52
	Panhandle section	10,000	.43	4,298.71
	Total	76,180	.39	29,693.61

[a] Of this amount $1,000 was paid by the agricultural and economic geological survey of North Dakota.
[b] These figures do not include portions of these areas surveyed in preceding years.
[c] Of this amount $607.55 was paid by the West Virginia geological survey.
[d] Of this amount $212.74 was paid by the West Virginia geological survey.

Total areas surveyed and mapped in the several States during the fiscal year ended June 30, 1909, and the areas previously reported.

DETAILED.

State.	Work during 1909.	Work previously reported.	Total.	
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Acres.*
Alabama	5,551	12,817	18,368	11,755,520
Arizona		611	611	391,040
Arkansas		2,677	2,677	1,713,280
California	1,725	8,446	10,171	6,509,440
Colorado		2,428	2,428	1,553,920
Connecticut		518	518	331,520
Delaware		314	314	200,960
Florida	500	2,973	3,473	2,222,720
Georgia	1,094	3,272	4,366	2,794,240
Idaho		1,281	1,281	819,840
Illinois		5,925	5,925	3,792,000
Indiana	667	3,537	4,204	2,690,560
Iowa		2,303	2,303	1,473,920
Kansas		3,175	3,175	2,032,000
Kentucky		2,049	2,049	1,311,360
Louisiana	510	6,956	7,466	4,778,240
Maine	525		525	336,000
Maryland	155	3,629	3,784	2,421,760
Massachusetts		796	796	509,440
Michigan	572	3,788	4,360	2,790,400
Minnesota		2,197	2,197	1,406,080
Mississippi	881	6,905	7,786	4,983,040
Missouri	866	5,093	5,959	3,813,760
Montana		432	432	276,480
Nebraska		3,116	3,116	1,994,240

Total areas surveyed and mapped in the several States during the fiscal year ended June 30, 1909, and the areas previously reported—Continued.

DETAILED—Continued.

State.	Work during 1909.	Work previously reported.	Total.	
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Acres.*
New Hampshire	....	923	923	590,720
New Jersey	....	1,303	1,303	833,920
New Mexico	....	129	129	82,560
New York	1,339	5,598	6,937	4,439,680
North Carolina	1,332	9,275	10,607	6,788,480
North Dakota	1,453	4,578	6,031	3,859,840
Ohio	....	4,183	4,183	2,677,120
Oklahoma	....	1,160	1,160	742,400
Oregon	249	446	695	444,800
Pennsylvania	953	4,025	4,978	3,185,920
Porto Rico	....	330	330	211,200
Rhode Island	....	1,085	1,085	694,400
South Carolina	1,694	6,306	8,000	5,120,000
South Dakota		675	675	432,000
Tennessee	1,395	4,742	6,137	3,927,680
Texas	1,913	13,192	15,105	9,667,200
Utah	....	1,501	1,501	960,640
Vermont	....	227	227	145,280
Virginia	....	5,887	5,887	3,767,680
Washington	....	1,652	1,652	1,057,280
West Virginia	1,062	1,777	2,839	1,816,960
Wisconsin	....	2,537	2,537	1,623,680
Wyoming	....	309	309	197,760
Total	24,436	157,078	181,514	116,168,960

RECONNOISSANCE.

State.	Work during 1909.	Work previously reported.	Total.	
Western North Dakota	39,240	....	39,240	25,113,600
Northwest Pennsylvania	8,112	....	8,112	5,191,680
Southwest Pennsylvania	2,016	....	2,016	1,290,240
Southern Texas	16,812	....	16,812	10,759,680
Panhandle, Texas	10,000	....	10,000	6,400,000
Total	76,180	....	76,180	48,755,200

GENERAL STATUS OF SOIL-SURVEY WORK AT THE END OF THE FISCAL YEAR 1909.

With the completion of the fiscal year 1909, soil surveys had been undertaken in each State in the United States except Nevada. The largest area completed in any single State is in Alabama, where on June 30, 1909, a total of 18,368 square miles had been covered by soil surveys. A little less than one-third of this total was completed during the fiscal year, this large amount of work being possible through the direct cooperation between the Alabama state department of agriculture and the Bureau of Soils, the Alabama authorities furnishing trained field assistants and contributing toward the maintenance of the work the sum of $6,572.55 in addition to the amount expended by the Bureau of Soils. Large areas have also been completed in the States of Texas, North Carolina, and California, and the work is being pushed as rapidly as the available funds and men will permit in all of the principal agricultural sections of the United States. A total area of 181,514 square miles had been covered by detailed soil surveys to June 30, 1909, and, including reconnoissance work, the total area surveyed on that date amounted to 257,694 square miles.

SOIL-SURVEY WORK IN COOPERATION WITH STATE ORGANIZATIONS.

There has been an increasing disposition on the part of various state agricultural organizations to request that the Bureau of Soils should enter into some form of active cooperation with them in the prosecution of soil-survey work in various States. Wherever possible arrangements have been made with such organizations whereby not only were the services of properly trained local men secured for the conduct of the work, but also in the majority of cases substantial state appropriations were secured to aid in defraying the expenses of the work.

In Alabama cooperation with the Alabama department of agriculture and industries has been in progress for more than eighteen months, and already more than two-fifths of the total land area of the State has been covered by detailed soil surveys. The State has appropriated the sum of $10,000 annually for this cooperative work, and the Bureau of Soils is spending a like amount. Each organization furnishes four or five trained field men who work in parties of two. Each year it is possible to map the soils of eight to twelve counties on the scale of 1 inch to the mile, and even more rapid progress will be made in the future, on account of the increased familiarity of the men with the soils encountered. Within the next three years it is anticipated that a complete detailed soil survey of the State can be finished.

In Maryland cooperation has been entered into with the Maryland geological survey, and the soil survey of the State is progressing at the rate of not less than one county each year. The results of these surveys are published, not only by the Bureau of Soils but also by the Maryland geological survey, as a part of the reports upon the geologic and economic resources of the State.

Cooperation has been entered into with the Mississippi geological survey whereby both organizations will contribute men and funds toward the completion of a soil survey of that State. Each organization will furnish two field men, and the expenses for field work will be equably shared. Surveys of not less than two counties will be made each year, and it is hoped that this rate of progress can be materially increased.

In the State of Missouri cooperation has been arranged whereby the State College of Agriculture and Experiment Station will furnish men and funds toward the completion of a soil survey of the entire State. The State and the Bureau of Soils will each expend not less than $7,500 a year upon this work. The region of the Ozark Plateau will be covered by a reconnoissance soil survey only, but the remaining two-thirds of the State will be covered by detailed soil surveys. The State is able to contribute the services of an expert of the highest experience and training to assist in the prosecution and direction of this work.

In New Jersey the agricultural experiment station and the geological survey join to cooperate with the Bureau of Soils in soil-survey work. In addition to the regular areal field work of the soil survey, the state officials will also conduct additional agricultural investigations based upon the results of the soil-survey work. About $1,500 will be expended annually by the Bureau of Soils in this cooperation.

Cooperation with the New York State College of Agriculture is being continued, and the state authorities are furnishing both trained men and a considerable fund of money toward the progress of the work. Not less than two counties are assigned for detailed soil survey each year, and some reconnoissance work is also being carried on. In addition the state authorities are accompanying the soil surveys with horticultural and agricultural surveys, besides conducting extensive field experiments upon the soil types determined and outlined by the surveys.

The North Carolina department of agriculture is continuing the cooperation begun nearly at the inception of soil-survey work in the United States and is furnishing both men and money for the more rapid progress of the work in the State. Four to six counties are covered by detailed soil surveys each year. The state department is also establishing experimental farms upon the principal soil types encountered in the State, and has employed experts to follow the soil-survey work with practical directions to the farmers for the proper cultivation, tillage, fertilization of the soils, and information regarding the adaptation of crops to the different types of soils.

In North Dakota the existing cooperation with the agricultural and economic geological survey has been continued. The expenses of the soil expert furnished by the Bureau of Soils are borne by the State while he is at work within its boundaries. Experimental work is also being conducted by the State in the areas where soil surveys have been completed.

In Pennsylvania a soil expert from the State College of Agriculture is annually employed by the Bureau of Soils in the prosecution of work within the State. At an early date it is anticipated that further cooperation will be arranged.

In South Dakota an expert from the State College of Agriculture is detailed to work with the reconnoissance soil-survey party of the Bureau of Soils working in that State. This work will be completed within the present fiscal year.

Arrangements have been made by the geologic survey of the State of Washington whereby the Bureau of Soils is cooperating in a reconnoissance soil survey of the logged-off lands of the Puget Sound region. Men and funds are furnished by the geologic survey and in addition other survey work by the state authorities will be based upon the results of this survey when completed.

The West Virginia geological survey is cooperating with the Bureau of Soils in making a detailed soil survey of the entire State. The soil experts are furnished by the Bureau of Soils, and their expenses while engaged upon soil-survey work in the State are borne by the State. In addition to the regular publication of the reports, the geological survey publishes the soil surveys as a part of its reports upon the economic resources of the State. Not less than three counties are being surveyed each year, and the director of the West Virginia geological survey urgently requests the more rapid prosecution of the work.

A cooperative agreement has been arranged with the Wisconsin College of Agriculture and Experiment Station and the Wisconsin geological survey for the completion of a soil survey of the entire State. About one-third of the State will be covered by a reconnoissance survey of the cut-over timber lands to determine what lands possess a paramount value for agriculture and what areas should be devoted to forestry. The remaining agricultural area of the State will be covered by a detailed soil survey by counties. Trained soil experts are furnished by both the state authorities and the Bureau of Soils, and their expenses are borne by their respective organizations. It is anticipated that the soil-survey work in the State can be completed within a period of five or six years.

Through these arrangements for cooperation by qualified state organizations, the progress of soil-survey work in all of the interested States is accelerated. The facilities of the Bureau of Soils for the inspection and correlation of the work are made available to the local organizations, and thus uniformity of methods and results is secured. The soil formations, of course, extend from State to State, irrespective of boundaries, and uniformity of classification and nomenclature is necessary if the full value of the work is to be realized. The Bureau of Soils or some such federal office alone can accomplish such results through a study of the soils upon a national scale. The results of work done in all States are made available for the use of all, whether cooperation is secured with the particular State or not.

The saving in expense of administration is also a great factor in the economical prosecution of the work, since unnecessary duplication of organization is eliminated. The inspection work is conducted by experts from the Bureau of Soils, who have had the most extensive training and experience in soil classification and mapping in all sections of the country. At the same time the benefit of special local knowledge upon the part of state officers is secured. In addition the work is made immediately applicable to the needs of the local organizations charged in each State with the administration of agricultural affairs, and in almost all cases the soil-survey work as rapidly as completed is followed by experimental or other investigational work on the part of the state organizations.

So far as is possible under the annual status of the appropriations for the Bureau of Soils, it is the policy of the Bureau to enter extensively into cooperation with state organizations for the prosecution of detailed and reconnoissance soil surveys.

RECOMMENDATIONS FOR FUTURE WORK.

Although a total area of more than 181,000 square miles has been covered by the detailed soil-survey reports and maps, and although an additional area of more than 76,000 square miles has recently been covered by rapid reconnoissance soil surveys, it is absolutely impossible for the Bureau of Soils at the present time to meet the demands which come to it annually for exact and detailed information concerning soils and their capabilities in the different portions of the United States. Nor can it begin to comply with the many requests for additional soil surveys which shall present this information in concise and dependable form for areas not yet entered upon.

Every year there is an increasing demand from citizens of the United States that the Bureau of Soils should furnish accurate information concerning the character and extent of different classes of soils, not only in those sections of the United States where agricultural settlement is going on rapidly, but also in the older agricultural communities, where changes in economic conditions and shifting in the centers of both commercial and agricultural population have brought about radical changes in the character of the agriculture.

The requests for information are largely those of individuals who, having sold land in one portion of the United States, desire to remove to some other locality for the sake of taking up land and entering upon agricultural pursuits in a new locality. Hundreds of letters, bearing requests for information concerning the soils of all portions of the United States, are annually answered from the information which has already been gathered by the Bureau in the prosecution of soil-survey work. The distribution of the soil surveys up to the present time has enabled the experts of the Bureau to furnish accurate information of this character concerning considerable portions of all of the agricultural sections of the country, but the mere fact that less than 200,000 square miles of territory has thus far been covered by the survey makes impossible the definite reply to many such inquiries.

In addition to the requests from individual citizens, who upon their own account desire to invest in agricultural lands in communities remote from their present homes, there are many requests for accurate information concerning the soils which are sent to this Bureau by organizations or firms charged with the investment of funds, either directly in farm land or in securities dependent upon the character and capabilities of farm lands of extensive areas. Wherever possible, detailed information derived from the soil-survey work is furnished in response to such inquiries.

At the present time a large number of inquiries is being received each year for information concerning the character, fertility, and crop adaptation of lands lying west of the one hundredth meridian which are competent, either with dry-land methods of farming or with irrigation, to produce crops. These inquiries come chiefly from persons of more remote localities, who desire either to purchase land outright or to take up land under the various federal acts which provide for the allotment of the public domain. In connection with these inquiries, it seems absolutely necessary that additional provision should be made for the extension of soil-survey work, not only through the Great Plains section, as is being accomplished by the reconnoissance soil survey, but also throughout a broad extent of territory lying between the Rocky Mountains to the east and the Sierras to the west, and included in what is generally known as the Great Basin region. The success of dry-farming methods in more eastern localities, the extension of railroad facilities throughout this general region, and the pressure of population are all leading to the settlement of lands which for years have been popularly considered to be unavailable for agricultural purposes. In order to meet this demand for information concerning arid and semiarid lands, there should be a considerable extension of the soil-survey work in the western division. In this same division, also, the occupation of cut-over timber lands for agricultural purposes, the extension of irrigation farming, under both the federal reclamation projects and the projects developed through the operation of the Cary Act, require detailed and careful examination of considerable tracts of irrigable land.

To aid in the development of the federal reclamation projects, it is considered desirable that detailed soil surveys should be made of each of these reclamation tracts, in order that a careful and accurate statement of the kinds of soil and their capabilities may be presented to new settlers and users of water rights. So far as possible assignments of soil surveys have been made during the past eighteen months to cover reclamation projects which are completed or are nearing completion. The funds for this character of soil-survey work are at present inadequate.

In connection with the soil-survey work carried on in cooperation with the different state authorities, there is at present a greater demand upon the resources of the soil-survey organization than the Bureau is able to meet and at the same time give just consideration to all of the other classes of requests for work which come to it. It is desirable that in the prosecution of this cooperative work there should be available for annual expenditure in the State of New York not less than $3,500; in the State of New Jersey, not less than $2,500; in the State of West Virginia, not less than $2,000; in the State of North Carolina, approximately $4,000; in the State of Alabama, about $12,000; in the State of Mississippi, about $2,500; in the State of Missouri, about $7,500; in the State of Wisconsin, about $8,000; in the State of North Dakota, about $1,200; in the State of South Dakota, about $1,000; in the State of Washington, not less than $5,000; and for the contingencies of additional cooperative work in other States, which are as yet unable to furnish financial cooperation, but which desire at least the cooperative spirit in the prosecution of work, not less than $15,000 additional.

In the majority of cases the sums enumerated will be fully or partly met by the appropriation of state funds to aid in the prosecution of the work. In practically all of these States the soil-survey work as conducted under the general guidance of the Bureau of Soils constitutes a definite and fixed part of the programme of the state authorities for the encouragement of agriculture and the betterment of agricultural conditions. In several cases, as already pointed out, additional agricultural and horticultural surveys are conducted by the States themselves, and both of these lines of activity are fundamentally based upon the results of the soil survey.

Mention has been made in the previous reports of this Bureau of the necessity for reconnoissance soil-survey work in the cut-over timber land sections of the Great Lakes. In cooperation with the State of Wisconsin, work of this kind has been begun in that State. The same conditions of idle deforested land, of which but little is known, also exist in the contiguous States. From the small amount of detailed soil-survey work thus far done in these nonagricultural sections of Michigan, Wisconsin, and Minnesota it has been absolutely demonstrated that millions of acres of farm land well suited to the production of valuable crops can still be found ready for occupation in those three States. It would seem that the importance of a preliminary investigation of the lands should result in an appropriation available for the completion of the work. If soil surveys could be completed at an early date, locating the agricultural land still unoccupied but capable of profitable occupation in these three States, the actual occupation of the area would be hastened as in no other way.

There are increasing demands from the general public and from the localities concerned, that the Bureau of Soils should undertake a systematic examination of large areas of swamp land, located particularly in the South Atlantic and Gulf States. Local experience has in some instances proved that these areas are capable of reclamation by drainage, and of agricultural occupation of the most intensive sort. In others the question is in some doubt and needs investigation by the trained men of the Bureau. These lands constitute a vast body of reserve agricultural land, and their reclamation by drainage directly follows as a corollary of the reclamation of the arid lands by irrigation. There is a great difference in the character of the soils of different swamp and marsh tracts, due to differences in the method of formation and differences in the materials which have been carried into these areas from surrounding upland; in fact, the swamp lands differ in their soil characteristics almost as greatly as the upland soils of the regions in which they occur. As a result, in the occupation of these lands decidedly different results are secured upon different tracts of swamp soils, and before any individual or corporation or state government can be assured of the necessity and desirability for drainage, their examination from the standpoint of the soils which they contain must be made. Otherwise no accurate estimate of their agricultural value can be formed.

Soil-survey requests on file.

State or Territory.	Number of areas.	Total area.	State or Territory.	Number of areas.	Total area.
		Sq. miles.			*Sq. miles.*
Alabama	22	16,240	Nebraska	14	19,774
Arizona	1	6,147	New Hampshire	2	1.087
Arkansas	23	16,092	New Jersey	2	363
California	30	69,822	New Mexico	2	14.328
Colorado	3	3,359	New York	17	15,407
Delaware	1	1,646	North Carolina	37	19,237
Florida	22	23,409	North Dakota	5	13.317
Georgia	39	16,155	Ohio	4	2,056
Idaho	4	10,330	Oklahoma	25	....
Illinois	6	4,631	Oregon	13	39,706
Indiana	19	8,052	Pennsylvania	15	10,817
Iowa	7	4,184	South Carolina	24	19,201
Kansas	7	5,470	Tennessee	61	25.359
Kentucky	6	2,349	Texas	63	65,179
Louisiana	16	17,716	Utah	5	14,016
Maryland	2	1,018	Vermont	1	788
Massachusetts	3	1,142	Virginia	30	11.302
Michigan	19	12,488	Washington	5	11,340
Minnesota	7	10,941	West Virginia	9	5.280
Mississippi	27	18.168	Wisconsin	11	8,683
Missouri	39	23.903			
Montana	6	75,266	Total	654	645,768

In spite of the utmost exertion to comply with requests for additional soil surveys, it remains a fact that annually a larger number of requests for additional soil surveys is placed on file at the Bureau of Soils than can be complied with each year with the men and funds available for this character of work. In addition to the demand as expressed by the general public, there is an increasing demand from state organizations for soil-survey work in connection with their investigations and demonstrations, and an increasing demand on the part of other Bureaus of the Department that soil-survey work shall be undertaken as a fundamental preliminary for the prosecution of lines of work intrusted to such offices.

Taking into consideration the different demands for work and the different sources from which they come, the distribution of soil-survey assignments which will to the largest degree meet and satisfy all of these demands has annually been made.

SOIL-WATER INVESTIGATIONS.

The investigation of soil erosion has extended to the means of preventing storm wash and also to the normal relations between soil and water—including what may be termed the duty of water in agriculture.

Water is the chief substance required in crop production. Most annual crops are sustained by a layer of soil little thicker than plow-depth—say a vertical foot. Such a layer of moderately friable soil weighs some 2,000 tons per acre; properly cultivated it remains productive without appreciable diminution for years, probably for a generation or a century. To be kept productive, it requires moisture to an amount seldom appreciated. Corn or small grain seldom yields well without a water supply (from rain or irrigation) of one or more acre-feet, according to texture, during the growing season; sure and abundant yields require from 2½ or 3 to 5 or 6 acre-feet during the year; the average for ample production is some 4 acre-feet yearly, equivalent to a rainfall of 48 inches. The weight of 4 acre-feet of water is 5,440 tons, i. e., about two and three-fourths times the weight of soil needed to yield crops for a series of years.

The total water supply of the country is derived from rain and snow; it is about 215,000,000,000,000 cubic feet, or something less than 1,500 cubic miles annually, equivalent to ten Mississippi rivers. This supply is a chief source of the productivity—indeed, of the habitability—of the country, and hence is a primary natural resource. It is made available chiefly through agriculture; and, measured by the best standards of farming, more than 5,000 tons yearly are required for the maintenance of each inhabitant. Our almost 2,000,000,000 acres would suffice for an agricultural and mixed population of over 2,000,000,000, so far as the land is concerned; but under present standards the water supply could not be made to sustain a population of 1,000,000,000. Both the utilization of the water and the development of standards must begin with the farm; the full duty of water can avail only through the American farmer.

The rainfall of the country, on which the productivity of the land and the life of the people depend, is variable. About a million square miles of our territory—a greater area than that of Phœnicia, Babylonia, Egypt, Palestine, Greece, Italy, Spain, Portugal, France, Germany, Denmark, Scandinavia, and the United Kingdom, or all those countries which have shaped the world's history—are insufficiently watered, and can be made fully habitable only by careful use of the whole of the scanty supply, coupled with the selection and development of crop plants adapted to arid conditions. Some 50,000,000 acres of our most fertile soil are wet or liable to overflow; and this vast area, capable of sustaining a population of over 50,000,000, can be made useful only by drainage and other devices for controlling the natural water supply.

In all sections, whether arid or flooded or in the intermediate States best adapted to farming, the availability of the land for plant growth and animal life depends on the associated water. Viewed in the large way, the soil is a medium connecting the inorganic earth with the organic world, and forms an entity no less definite than the flora or the fauna. The product of interaction between organic and inorganic, it has its own laws of action and reaction, of development and decadence, of continuity and differentiation. It is efficient or inefficient according to its constitution and functions; it is becoming clear that its efficiency depends largely on its capacity for conserving and conveying water for plant growth; and the most convenient measure of its efficiency, as of the agricultural duty of water, is productivity.

Special investigations of soil water in its relation to productivity were made in connection with the soil-survey parties in South Dakota and in the State of Washington.

In central South Dakota the rainfall averages little more than 15 inches; yet the subsoil and the Cretaceous shales below are moist to a degree evidently greater than can be ascribed to that precipitation. The region is artesian, flowing wells occurring wherever the shales are drilled through to the Dakota sandstone hundreds or thousands of feet below—the sandstone outcropping in the foothills of the Rocky Mountains, and inclining eastward beneath the younger shales. While the shales form the confining stratum or cover for the sandstone they are more or less pervious, and under the hydrostatic head of hundreds of thousands of feet a part of the water escapes upward to exude slowly at the surface and evaporates either directly or through the action of growing plants. While the quantity of water supplied by this natural subirrigation system has not been measured, it is estimated at an inch per month or a foot per year, which with the 15 inches of rainfall suffices for moderate productivity. These conditions extend beyond South Dakota throughout a considerable portion of the Great Plains, affecting an area of several million acres. This is a region of successful dust mulching and "dry farming," for the dust layer at the surface not only retains much of the moisture derived from the rainfall but conserves the subterranean supply for the use of the crops. Thus the season's work shows that the productivity and habitability of the Great Plains are greatly increased by a natural subirrigation which renders available for agriculture not only the local precipitation but a part of the rain descending on a nearly equal area of broken country extending westward into the mountains.

In eastern Washington and adjacent parts of Idaho there are several classes of land considered in relation to water supply and productivity. The most extensive comprises the lava beds of the largest known area of volcanic rock, over which the rainfall averages little more than 20 inches, i. e., not enough for full productivity. Portions of the lava are deeply decomposed, yielding a pulverulent and friable soil and subsoil well adapted to retaining water from either rains or irrigation; these form the far-famed wheat lands in which dust mulching is advantageous and the product abundant every year or once in two or three years according to the water supply. Elsewhere the lavas are decomposed to less depths, and here a considerable part of the rainfall is lost by percolation through the porous and cavernous rocks, perhaps to reappear as springs and seepage in the valleys, and the productivity is limited and uncertain. Another class of lands includes those of the mountains and foothills, usually wooded and too broken for agriculture; they form catchment areas for streams, which are notably clear and uniform throughout the year so long as the forests remain but become turbid and torrential with deforestation. A third class of land occurs in valleys, usually lined with gravel, through which water percolates freely. When the ground water reaches the surface forests of cedar and hemlock abound, and when the land is cleared drainage is required; when the water table is a few feet lower the surface is wooded with upland trees and when cleared the soil is highly productive, and when the water table lies at a depth the lands are treeless and virtually unproductive without irrigation, though in some cases (as in Spokane Valley) the underflow is so abundant as to sustain irrigation by pumping with high productivity. The three classes of lands illustrate the varying efficiency of soils yet demonstrate the direct dependence of productivity on the water supply.

Much of western Washington bears remarkably exuberant forests and undergrowth, dominated by Douglas firs 200 to 300 feet in height, sustained by ample though variable winter rains. The coverlet of lofty trees, the blankets of brake above and of broadleaf annuals below and a sheet of moss on the surface, check evaporation from the abundant mulch and humus-charged topsoil and form a veritable jungle, dank and nearly impassable, which acts as a sponge, absorbing and holding the winter's water for the summer's growth. The subsoil is a hard silty or gravelly till, lying much as it was left by the late Pleistocene glaciers, through which moisture percolates freely and is sucked downward hydrostatically to a base level of ground-water rising gently from the shores of the Sound to the foothills of the mountains, and beneath the second and third benches, comprising an area of several thousand square miles, the jungle on the surface passes into absolute desert 2 feet beneath. Even the noblest firs are merely balanced on wide-spreading root systems (which when upturned are flat as the wall of a house), whence the rootlets turn upward into the humus and mulch, while the roots of brake and other annuals ramify even nearer the surface. Manifestly the jungle is a natural sponge which has pushed over the sieve-like till since the glaciers withdrew, though some of the most porous areas remain barren or sparsely grassed, and when cleared by logging and firing the uplands are liable to revert to the original barren condition. Nature's adaptation—or device, if it may be so designated—operated intensively to develop a vital mechanism for conserving water rather above than beneath the surface, and it seems clear that only intensive agricultural methods will suffice for the utilization of the upland silts and gravels when the water-conserving cover is removed. The individual soil types are, as usual, distinctive and adapted to special uses; yet the efficiency of each is largely determined by a common factor—the quantity of the water supply and the capacity of soil and organic cover for conveying and conserving water.

The three districts show strikingly the larger relations between soil and water, and the more precise physical interactions controlling these relations are under investigation.

SOIL-FERTILITY INVESTIGATIONS.

Considerable progress has been made during the year in the investigation of infertile soils and the causes which lead to fertility and infertility of our agricultural lands. Part of the investigations have been along the line of determining the fundamental factors conducive to the most fertile conditions in soil. Especial stress has been laid during the past year on the further examination of the organic matter of soils, and its influence upon crop growth and the maintaining of the proper soil conditions has been well recognized. The average content of organic matter in the soils of the United States, as determined by the analysis of several thousand soils, is 2.06 per cent for the soil and 0.83 per cent for the subsoil. The organic content of an acre of soil amounts, therefore, to about 50 tons. Of this organic matter almost nothing has been known definitely in the past, although its fundamental importance in maintaining proper soil conditions has long been recognized. An investigation into the origin, transformation, destruction, and accumulation of this organic matter has been made, and much valuable information concerning its effect in promoting or hindering crop production has been obtained. There have been isolated from the soil a number of very definite organic bodies, crystalline in appearance and possessing properties, in some cases harmful, in other cases neutral, and in still others beneficial to the growth of crops.

In addition to the isolation and study of these definite crystalline bodies, a great deal of valuable information has been collected concerning the rest of the organic matter, which is not obtainable in this pure form, but of which the properties have been determined by study. As a result it has been found that the organic matter of different soils differs very widely indeed and that the organic changes which the plant débris is subjected to vary greatly in different regions of the United States under the varying conditions of temperature, rainfall, and lime content of the various regions. There have arisen under these conditions soils containing entirely different forms of organic matter, resulting from the different forces which have caused decay under these varying influences of climate. The cultural methods also in any one region have produced changes in the organic matter of the soils, and this has been shown to be true not only of the strictly cultural methods, but also of other treatments given to the soil, such as the application of lime and various forms of fertilizers. In other words, the application of lime or the application of sodium nitrate, or potash, or phosphate has had the effect of causing the change in the organic matter to proceed in a different direction from that which occurs in the soil when these bodies have not been added. In this way much valuable information concerning the action of fertilizers in influencing decay and other biochemical processes within the soil has been obtained.

Some of the bodies isolated from soils have been studied in a more detailed way to establish the influence of mineral soil constituents and fertilizer salts upon their destruction and their amelioration where they have a harmful effect on crops. In these investigations it has been found that the single fertilizer salts are never so efficient in promoting growth as combinations of two of the salts, and these in turn are never so efficient as combinations of three or more fertilizer salts, even if the third is present in rather small proportions. It has also been found that under these better conditions of fertilization the plant is more able to withstand the harmful effects of some of these compounds, and may under these conditions be so affected that it will itself destroy or alter by oxidation through its roots these unfavorable soil ingredients.

In regard to the destruction of these bodies where they occur in soils as a result of unfavorable soil conditions, it has been found that the best way at the present time to purify the soil of them is by oxidation; hence the importance of those operations which favor and the application of substances which assist oxidation. Among these, thorough cultivation and the growing of deep-rooted crops are especially desirable, and subdrainage is also strongly recommended to attain this end, because of the greater penetration of the oxygen of the air into the soil, as well as removal of the harmful materials themselves in the drainage or seepage water. The application of lime also favors these changes of oxidation, as the process takes place more rapidly following its use. Further, the application of such fertilizer salts as nitrates tends to increase the degree of oxidation and through their action to reduce the amount of the harmful organic bodies in soils, producing on the whole very beneficial alterations in the soil organic matter. Other researches on the action of oxidizing agents in promoting this betterment of soil conditions are in progress, and some interesting results are already indicated.

It has further been found that productive soils possess a decided oxidizing power themselves, whereas this property is lacking or greatly diminished in unproductive soils. It follows, therefore, that in productive soils we have the processes naturally present which tend to a proper change of the organic débris in the soil, changing this to such compounds as are either inert or beneficial to the growing crops. This oxidizing power in the soil appears in some cases to be due to the presence of enzyms or other catalytic agents, and the recognition of this property in soils with its bearing on the problem of the biochemical changes in soil is of the utmost significance.

In addition to the direct influence of the organic matter of the soil upon the crop growing therein, either favorably or unfavorably, there have been noticed other effects of the organic matter. Important among these are its influence on the other great controlling factors in crop production, such as the solubility of the soil minerals, the physical structure of the soil granules, as influenced by the presence of different forms of organic matter, and the action of water or the water-holding power of the soils. To illustrate the results of these investigations, it might be mentioned that there was found from California a soil with some marked peculiarity which would not permit it to become properly wetted, either by rain, irrigation, or movement of water from the subsoil, with the result that this land could not be used for profitable agriculture. An investigation showed this property to be due to the organic matter in the soil, which was of such a nature that, when extracted, it had all the properties of a varnish, repelling water to an extreme degree. The soil, once freed of this organic ingredient, had a high water-holding power. From still other soils, bodies of an extremely waxy nature have been isolated, and it can thus be seen that cetain kinds of organic matter are important as the cause of the low water-holding power of some soils, although in general under favorable conditions the presence of the organic remains of plants increases the power of soils to hold moisture—an important factor in crop production. The isolated organic matter from such soils shows this to have a high ability to hold water either physically or in loose chemical combination.

A further research has been in progress, in cooperation with some of the experiment stations, on the changes which have been produced in soils under long-continued cropping or long-continued fertilizer application. For this purpose one of the parties has been detailed to the Pennsylvania station for a study of the twenty-five-year fertilizer plots at that station and some very interesting results have already been obtained. This line of work is being continued at this and other stations in order to throw light upon the influence of these long-continued soil treatments upon the chemical and physical characteristics of the soils and the biochemical differences produced in them.

The study of the influence of root oxidation on the organic matter in the soil as well as the effect of fertilizer salts in promoting this oxidation has been continued, and it has been found that this oxidizing power of the plant roots, especially in the presence of fertilizer salts, is capable of inducing changes in the organic matter of the soil, altering in many cases the least oxidized forms harmful to plants to higher oxidized forms which have no effect upon the plant. In connection with this study it has also been found that the plant root possesses a reducing action which under certain conditions can become quite prominent. The influence of this on problems of fertility is not yet understood and is the subject of further study.

LABORATORY INVESTIGATIONS.

In the laboratories, the amount of routine work required for the support of the field investigations of the Bureau has continued to increase in spite of every reasonable effort to reduce it to a minimum. But the demands from other Bureaus and officers of the government service have grown enormously within the past year, the demands of some of the other Bureaus of the Department being as great as those of the Bureau of Soils. The facilities at our command have been stretched to the limit, and to handle properly the present demands upon us, without considering the probable increase in such demands, urgently requires increased facilities in men and material.

The great increase in routine work has materially affected the investigations being conducted in the laboratories on the fundamental physical and chemical properties of soils. Nevertheless, some important advances have been made. It is now being realized, and mainly as a result of the investigations of the laboratories of the Bureau of Soils, that the meager progress in soil investigations in the past has been due to the prevalence of an incorrect point of view, i. e., the soil of any particular field or area has been regarded as relatively fixed in position. The problems presented have been attacked from a static point of view. As a matter of fact, in the relation of crop production to soils, every factor—for instance, the plant roots, the solid particles of the soil, the soil moisture, the soil atmosphere, soil bacteria, etc.—is constantly undergoing change or is in motion, so that each and every soil problem is essentially a dynamic one, and it is becoming increasingly clear that for any real progress the soil must be studied from a dynamic standpoint. The root of the living plant is always in motion, or the plant dies. The solid particles of the soil are more or less constantly being carried from place to place by flood waters, and by winds especially, the investigations of the Bureau showing the amount of such translocation and the distances involved to be enormous. It has also been shown that the individual particles of the soil are constantly in motion as the soil is becoming wetted or is drying, as the result of rain or subirrigation on the one hand, or surface evaporation and redistribution of the soil water on the other. Earthworms, burrowing insects and animals, frost action, and other processes are ever at work moving the soil particles.

It has been shown that the larger part of the annual rainfall enters the soil to return to the surface again, bearing dissolved mineral substances available for plant nutrition. In a similar way constant motion or change can be shown for every soil factor. Each of the three general methods of soil control, viz, cultural methods, crop rotations, and fertilizers, affects several at least of the soil factors, so that no simple theory can reasonably be expected to account satisfactorily for the results obtained from them. Soil theories in the past have failed, because they have been deduced from static rather than dynamic considerations, and because generally they have aimed at a simplicity which the facts, as now known, do not justify.

Especial attention has been given in the past year to a continuance of the investigations on the wind as a translocating and erosive agency. A large mass of evidence has been brought together and a bulletin prepared which is expected to be of prime importance to all soil investigators and students of surface geology. The practical results are no less important as bearing on the management of soils in areas much subject to excessive wind action. This condition is giving much concern in certain large areas in the far Western States, and occasionally in more restricted areas in the Eastern States, and help in this direction is timely and important.

One of the problems which have long occupied the attention of geologists and soil investigators alike is the cause of the differences between red and yellow soils, differences which appear to be associated with their productivity and to necessitate differences in their management. Work on this problem has been continued during the past year, and it now appears that no one cause is operative in all cases, sometimes physical, sometimes chemical, sometimes bacteriological agencies being involved.

In continuance of our researches on the effect of moisture content on the physical properties of soils, work has been done on the conductance of heat in soils and methods devised for getting around the usual theoretical and technical difficulties involved. As a result of this work we are in a better position to advise regarding the handling of soils for such crops as the cranberry, rice, and those adapted to wet lands generally.

Further work has been done in our researches on the chemical and physical properties of alkali and the attendant problems of chemical and physical hardpans, and an extensive field examination was carried on this summer to verify and extend the previous investigations of these important problems. Much new information has been acquired which is of practical value in advising the occupants of lands troubled with the various types of alkali and hardpan occurring in this country, and in working out methods for making available lands which are now sterile, but potentially among the richest in our domain.

The United States Geological Survey is at present engaged in locating and mapping the phosphatic deposits of the country. Our laboratories have been cooperating this past year, furnishing a man and equipment to do the necessary analytical work for them in the field, and carrying on important chemical investigations here in Washington. This work is of fundamental importance in determining the available future supplies of phosphatic fertilizers and the best means for their conservation and use. At the same time the laboratory investigations are being continued on the chemical and physical changes involved in the manufacture and storage of phosphatic fertilizers.

In continuation of the work on the mineral composition of American soils, which the laboratories of this Bureau have studied exhaustively from the chemical side, much work has been done on the nature and kind of mineral species in soils of various types and origin. Special methods of examining with precision the smaller sized grains have been developed within the past year, and we now know that even the smaller sized soil grains are made up largely of fragments of the common rock-forming minerals and not merely of decomposition products. This work is mainly of theoretical interest, although it has an indirect practical value in formulating a rational fertilizer practice. It has, however, some direct practical value in certain special problems. For instance, an extensive investigation has been conducted this past year, and is still in progress, as to the presence and distribution of barium and barium-carrying minerals in the soils of the United States, a problem which is now attracting much attention, since it is held by some authorities that the segregation of barium in certain types of plants is the cause of the destruction of cattle grazing upon them.

It is becoming increasingly evident that an intelligent soil control requires a more accurate knowledge of the physical as well as chemical properties of the soil solution, and work has been continued this past year along this line, special study being given to the condensation of water produced by such salts as are contained in commercial fertilizers. Unexpected results were obtained of great theoretical importance, and their importance to practical cultural methods is now being studied.

REPORT OF THE ENTOMOLOGIST.

U. S. Department of Agriculture,
Bureau of Entomology,
Washington, D. C., August 11, 1909.

Sir: I submit herewith an executive report covering the work of the Bureau of Entomology for the fiscal year ending June 30, 1909, dividing it, in accordance with your instructions, under the following headings:

(1) A summary of the important operations carried on during the fiscal year ending June 30, 1909.

(2) An outline of the plans proposed for work during the fiscal year ending June 30, 1910, under appropriations already made for that year.

(3) Plans of work recommended for year ending June 30, 1911.

Respectfully,

L. O. Howard,
Entomologist and Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

WORK OF THE YEAR.

The work of the year beginning July 1, 1908, and ending June 30, 1909, may be classified, with some modification from the classification of previous years, as follows:

(1) Work on the gipsy moth and the brown-tail moth.
(2) Importations of useful insects.
(3) Exportations of useful insects.
(4) Work on insects injurious to southern field crops.
(5) Investigations of insects damaging forests.
(6) Investigations of insects damaging deciduous fruit trees.
(7) Cereal and forage-plant insect investigations.
(8) Work on insects injurious to vegetable crops.
(9) Work on insects affecting citrus fruits.
(10) Investigations of insects in their direct relation to the health of man and domestic animals.
(11) Work on insects injurious to stored products.
(12) Inspection work.
(13) Work on bee culture.
(14) Unclassified work.

WORK ON THE GIPSY MOTH AND THE BROWN-TAIL MOTH.

Few innovations in the methods of the work on the gipsy moth and the brown-tail moth, as described in previous reports, have been made during the past year, and the work accomplished in preventing the spread of the moths has been quite satisfactory. They have been held within the bounds established a year ago, except in the State of New Hampshire, where a number of localities of occurrence have been discovered to the north of the region formerly known to be infested. It is not likely that a very great spread has occurred during the year, as most of these localities are places hitherto undiscovered but which have been infested for some time.

As in other years, the Bureau has cooperated to a great extent with the state officials of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut. As in previous years, governmental activity against the brown-tail moth has been quite limited, since all of the infested States have laws which require property owners to destroy this insect on private lands and requiring the municipalities to take care of the trees along highways.

The fight against the gipsy moth has been carried on continuously throughout the year in conformity with all the best known methods.

WORK IN MASSACHUSETTS.

In Massachusetts, which remains the most seriously infested of all the New England States, the agents of the Bureau have continued cutting underbrush and removing dead wood and undesirable trees to a distance of 100 feet back from the roadway on either side of the roads leading through the worst infested woodlands. Down to the close of the fiscal year about 300 miles have been cleared in this manner, and along the roads where this has been done the foliage was, on July 1, 1909, in nearly perfect condition, making it practically impossible for caterpillars to drop from trees anywhere through this section upon passing vehicles. In a few places the caterpillars on the foliage of trees on cleared roadsides were so numerous, especially on overhanging trees, that many of them were blown, as they hung suspended by silk, into trees which were being cared for, so that an additional strip of about a rod in width was cleared as a precaution to the roadside strips.

In addition to the cutting and pruning necessary, these strips have been sprayed with arsenicals, and much additional territory has also been thoroughly sprayed in localities where it has not been possible to clear roadsides.

Trees in the worst infested localities have been banded with tanglefoot and the caterpillars found below the bands have been destroyed daily. In some of the worst infested places the trees have been examined twice each day, in order that the caterpillars might be killed and thus kept from crawling out into the roads, where they could easily be picked up by vehicles.

Where the caterpillars were not so numerous, trees have been burlapped and the bands turned over when it seemed to be necessary. Occasionally property owners have objected to the amount of cutting needed, but in most cases they have been so well pleased with the result that they have cleared large tracts of underbrush at their own expense. Several towns in Massachusetts are also adopting the methods of the Bureau in caring for roadsides within their limits.

WORK IN NEW HAMPSHIRE.

During the summer of 1908 scouting operations in the woodlands of New Hampshire were continued with a force of 10 men. About November 1, when the leaves began to fall, additional trained scouts were sent into the State, who were among the most expert members of the force in searching for the frequently inconspicuous egg clusters of the gipsy moth. About 100 men were occupied in this way until the eggs began to hatch in May, 1909. This thorough scouting has revealed the presence of the gipsy moth in over 100 towns in the State of New Hampshire.

The infested territory in this State now includes all of eastern New Hampshire south of Lake Winnepesaukee, with a strip 2 or 3 miles deep west of the Merrimac River. The territory south of a line drawn from Dover to Nashua is badly infested, and from the present outlook there does not seem to be much hope of improving conditions under state supervision. In order to hold the gipsy moth in check in New Hampshire, the great bulk of the work must be done by the General Government, at least until additional appropriations can be made by the state legislature.

In addition to the territory found to be infested in all cases at least one town beyond the limits of the area known to be infested has been scouted, as well as territory even beyond these towns where there was any reason to suspect the occurrence of the insect.

The main route of travel for summer tourists up the Pemigewasset valley to the White Mountains, and the route from Ossipee to the mountains, as far as Bethlehem and Bretton Woods, has been gone over very carefully. No indication of the gipsy moth was found north of Ossipee, on the eastern route, nor north of Meredith, on the western route. During this scouting the men destroyed by creosote 371,102 egg clusters, and as each egg cluster contains about 500 eggs a potential army of gipsy moth caterpillars of great size was destroyed. During the summer and autumn a few miles of the roadside cutting, similar to that done in Massachusetts, was carried out.

WORK IN MAINE.

In Maine the state authorities carried the pay roll of the men engaged in the work until their funds became practically exhausted. The state organization was then taken over on the government pay roll, and most of the scouting work was done by the Bureau during the winter of 1908–9, in addition to such summer assistance as it was able to give. Down to the autumn of 1908 efforts in the State of Maine against the gipsy moth have been confined to orchard and roadside work, but during the past winter much woodland work was begun, and several colonies, some of which contained thousands of egg clusters, were carefully cleaned up, the underbrush was cut, trees were pruned, and the infested areas were put in condition for the coming summer campaign. Although more egg clusters were found during the past winter than during the previous year, the infested territory in Maine is now in better condition than it has ever been. The Government is assisting the State in the summer burlap work by carrying a large proportion of the state men on the Bureau pay roll.

The outbreak of the gipsy moth at the soldiers' home, near Augusta, seems to have been overcome, and the outlook for the whole State is encouraging.

WORK IN RHODE ISLAND.

The infested territory in Rhode Island shows continued improvement. During the winter of 1906–7, 80,000 egg clusters were discovered and destroyed. During the winter of 1907–8 only 7,500 could be found, and these were destroyed. During the past winter (1908–9) less than 1,700 egg clusters could be found, which indicates that the insect is rapidly approaching a condition of absolute extermination.

The State has been receiving practically the same assistance as the State of Maine. During the period when the state funds were available the operators were paid by the State, but during the remainder of the year they were carried on the federal pay roll.

During the summer of 1909, 150,000 trees were burlapped, and about fifty of the men caring for these burlapped trees have been carried on the federal pay roll.

During the past winter all of northeastern Rhode Island was carefully scouted, and no additions were found to the previously infested territory. Two towns previously infested have shown no indications whatever of the moth during this scouting, and in another town but one previously known colony continued to show evidences of the existence of the pest.

WORK IN CONNECTICUT.

As in previous years, the State of Connecticut has practically conducted its own campaign. But one large colony was ever known in this State, namely, in the vicinity of Stonington, and aside from sending one of the best federal scouts to that locality for two weeks, the State has not asked for assistance. But six egg clusters were discovered there during the past winter, and down to June 30 only 76 caterpillars were found. There seems to be every hope of the absolute extermination of this colony in the near future.

EXPERIMENTAL WORK.

Although perfectly satisfied that the methods adopted are sound, considerable experimental work has been carried on during the year, with a view of discovering easier and cheaper methods of handling the pest than had theretofore been known. In the course of this work several important discoveries have been made. It has been shown, for example, that pine trees can be protected by a tanglefoot band, even though carrying many egg clusters above the band, since it seems that the young caterpillars do not eat the pine needles, but drop from the trees in search of more tender food until such time as their jaws become sufficiently strong to eat pine leaves.

Experiments with different arsenical mixtures, with different pump pressures, and with different distributing apparatus, as well as experiments in the distribution of dry arsenate of lead upon wet foliage, have been carried out.

An important step in preventing the further spread of the gipsy moth has been taken in cooperation with the different railroad corporations operating within the infested territory. As the result of this cooperation an embargo notice against the shipment of lumber, cord wood, fence posts, railroad ties, and similar forest products went into effect July 1, 1909. The notice issued by the railroads places upon the shipper the responsibility of requesting inspection when such products are offered for shipment and of presenting a certificate of inspection to the railroads before they will accept the shipments. It is hoped in this way to eliminate such danger as may be threatened through these transportations.

THE BROWN-TAIL MOTH IN NEW YORK.

A small infestation of the brown-tail moth was discovered late in June near Port Chester, N. Y., just across the Connecticut state line. Only a few larvæ were found, and the infested area has been thoroughly burned over and sprayed by the state entomologist, Doctor Felt. No expense has been spared in the attempt to exterminate the insect at this point.

IMPORTATIONS OF USEFUL INSECTS.

As in previous years, the principal efforts of the Bureau in importing useful insects have been devoted to a continuation of the very large scale experiments in introducing from different parts of the world into New England the parasites and predatory enemies of the gipsy moth and brown-tail moth. The parasites have all been received at the gipsy-moth laboratory supported by the State of Massachusetts at Melrose Highlands, Mass., and their care has been assigned, as in previous years, to Mr. W. F. Fiske, of the Bureau.

As explained in the annual reports of the Bureau for the years 1905 and 1906, this work has been distinctly in cooperation with the State of Massachusetts, which has appropriated specific funds for the purpose. In 1905 Congress appropriated the sum of $2,500 for this work, but Massachusetts the same year made a much larger appropriation, and with the consent of the Secretary of Agriculture the Chief of the Bureau of Entomology was placed in charge. During the earlier part of the experiment nearly all of the expense attached to the work was paid by the State of Massachusetts. As the experiment has grown in size, however, it has been found necessary to assign a constantly increasing number of expert assistants from the Bureau of Entomology, until at the present time the General Government is expending in the work about as much as the State of Massachusetts. To the State, however, belongs the credit of having practically instituted the work and for having generously supported it in its full progress.

The writer visited Europe in May and June, 1909, and started forwarding agencies for parasites at Cherbourg, France, and Hamburg, Germany; visited agents and officials in Holland, Germany, Russia, Austria, Hungary, Switzerland, and France; studied the European situation thoroughly, discovered a new and most favorable locality in France, which will be worked to the utmost next summer, and secured largely increased sendings of parasitized material from many points.

Prof. Trevor Kincaid, of the University of Washington, at Seattle, who was sent to Japan during the spring and summer of 1908, and who had, by his successful shipments demonstrated his great ability in this direction, was sent to Russia in April, 1909, in order to secure as many as possible of certain apparently important parasites previously sent over by Russian agents and correspondents. Owing to various unforeseen conditions, and principally owing to deficient transportation facilities, the material received as the result of his expedition proved to be unsatisfactory on the whole.

Upon Professor Kincaid's own advice it was considered unnecessary to send a second expedition to Japan during the summer of 1909, since the Japanese entomologists had exhibited such a hearty and intelligent interest in the experiment, and the Japanese Government had shown itself so favorably inclined to assist. After a preliminary correspondence between the Secretary of Agriculture of the United States and the minister of agriculture for Japan, Prof. S. I. Kuwana, of the imperial agricultural experiment station at Tokyo, was designated by the Japanese Government to be its official representative in work to be carried on during the spring and summer of 1909. Professor Kuwana has shown himself to be a man of extraordinary intelligence and activity, and a number of interesting and valuable lots of parasitic material have been received from him at the laboratory at Melrose Highlands, Mass. This material was received in uniformly good condition, and this was due to the great care and intelligence shown by Professor Kuwana in its collection and the method of packing and shipping. The hearty thanks of the United States Government are due to the Japanese Government in this matter, and warm individual commendation and thanks are due to Professor Kuwana.

The most perfect service of the present summer was secured in France. Arriving in Paris on the 13th of May, the writer met, by appointment, Mr. René Oberthür, of Rennes, a French entomologist of high standing, and certain of his collaborators. Plans were considered, largely at the suggestion of Mr. Oberthür, which resulted in the institution of a very large scale service, principally in the south of France, and in the employment of a large number of collectors under expert supervision. From this arrangement several thousands of boxes of good material were received at the Melrose Highlands laboratory from this region. In quantity it exceeded the total of all other importations of a similar character made since the inception of the work, and from it have been reared a greater number of important Tachinid parasites than have been reared from all other importations of similar character taken together. Mr. Oberthür has taken up this work voluntarily as a private citizen of France, wholly without compensation, and entirely from his scientific and practical interest in a great piece of experimental work. The warm thanks of the United States, and particularly the New England States, are due to this remarkable man.

Another notable importation of the year consisted of several thousand egg-masses of the gipsy moth received during the winter from Prof. Josef Jablonowsky, director of the entomological station under the ministry of agriculture of Hungary at Buda-Pest. These were collected in various localities in Hungary, and after their arrival in Massachusetts there were reared from them and liberated under the most favorable conditions more than 75,000 egg-parasites of the species known as *Anastatus bifasciatus* Fonsc. This is especially noteworthy, since less than 1,000 of these parasites had previously been received from all localities, the earlier ones having come from southern Russia and from Japan.

In addition to these more or less unusual shipments, quantities of miscellaneous material have been received, for the most part in good condition, as formerly, from numerous collectors in Germany, Austria, Italy, Holland, Belgium, and Switzerland. Eggs, caterpillars, and pupæ of the gipsy moth, hibernating webs, caterpillars, and pupæ of the brown-tail moth, and adult predaceous beetles have been included in these shipments.

In beginning this large experiment in the importation of parasites there were three principal factors to be considered. First, the importation of living and healthy parasites in numbers sufficient to admit of colonization. For the most part this question has been solved, and the work of importation has become a mere matter of routine. The second question was the handling of the parasitic material after its receipt at the laboratory; and the third, what to do with the imported parasites in the field and how to ascertain results. The second problem, namely, how best to handle the parasitic material after its receipt, has also practically been solved. During the earlier years much time and trouble was expended in attempting to devise methods for doing what had never before been attempted upon a very large scale, but at the present time a comparison between the situation and that of four years ago shows that a large bulk of this work, like that of parasite importation, has resolved itself from a tedious and costly experimentation into a matter of routine. Improvements are to be expected and are being discovered. Attempts to secure reproduction of parasites under laboratory conditions have succeeded in a great majority of instances, and in a few wholesale breeding on a large scale has proved economically possible. Pteromalus, which attacks the hibernating caterpillars of the brown-tail, several brown-tail egg parasites, a newly imported egg parasite of the gipsy moth, and *Calosoma sycophanta*, a large predatory ground-beetle, have all been brought under complete laboratory control, and the numbers which it is possible to rear and colonize seem limited only by the expense of the work. The brown-tail egg parasites, however, seem not to be of as great economic importance as supposed.

A newly imported parasite of the gipsy moth eggs was received from Japan in the spring of 1909, for the first time in a healthy condition. Less than a score of these individuals, reared from these imported eggs, have been increased, through careful laboratory management, to more than 2,000, and it is confidently expected that enough will be reared before the close of the present year to allow a test of the efficiency of this parasite in the field.

With the Calosoma beetle the laboratory work during 1907 and 1908 has resulted in the complete laboratory control of the species, and a maximum of reproduction with a minimum of loss has been secured this year. In addition to a number of beetles imported directly from abroad, 6,000 larvæ have been reared in the laboratory and colonized, 100 or 200 in a place. Several other species of predaceous beetles have been imported, and, in some instances, colonized. With one or two possible exceptions, their disinclination or inability to climb into the trees in search of their prey make them of little value in the control of the gipsy moth, although when given the opportunity they will feed upon the larvæ and pupæ freely. Reproduction of several Tachinid parasites of the gipsy moth and brown-tail moth has also been secured in the laboratory, and work upon the biology of these parasites conducted by Mr. Townsend has resulted in many surprising discoveries which will have an ultimate practical effect.

The problem of colonization of laboratory-bred material and other material and the study of the imported parasites in the field is still open to a great deal of work. The statement made in the last annual report that "it is altogether likely that the species introduced had found conditions favorable to their increase, and that at the present time they exist in considerable numbers," has been strikingly upheld in one instance. A hymenopterous parasite (Monodontomerus), which attacks the pupæ of both the gipsy and brown-tail moths, was first recovered from the field in the early winter of 1908 and 1909, but has since been found fairly evenly distributed over the area of approximately 500 square miles. A similar rapid increase, rendered unnoticeable on account of an equally rapid and very widespread dissemination, can not be expected in every instance, but it is not unreasonable to suppose that it may occur in several.

Recent field work has discovered indications of a considerable spread of Calosoma from the immediate neighborhood of the original colonies, and it seems obviously only a question of a very short time before it will be distributed throughout the entire area covered by the gipsy moth.

Twelve species of introduced parasites and predatory species have been recovered from the field this year, as against six last year, although not all of these have demonstrated their ability to pass an entire year under their new geographical environment.

There have been imported in all, according to present classification, twenty-six species of Hymenopterous parasites. Of these, one or two are probably identical, although recognized under different names as they come from Europe or Japan. At least twelve of these are of very little promise. Some of them have been given thorough tests in the field, and others, on account of their exceeding rarity in connection with the gipsy moth or brown-tail moth, or for other reasons, can not be considered as important. There remain twelve, of which eight have been received in numbers sufficient to admit of the establishment of satisfactorily large and strong colonies. Nearly all of these have been recovered after at least one generation under natural conditions in the open, but not all after a complete year has passed. One more is soon to be liberated. The remaining three have never been received alive in numbers sufficient to admit of satisfactory colonization.

Of the twenty-nine species of Dipterous parasites mentioned in the last report as having been reared from the gipsy moth or brown-tail moth, a certain number may be eliminated for similar reasons. There are about seventeen of varying importance, all but two or three of which are, to all practical purposes, confined to either the gipsy moth or the brown-tail moth. Fifteen, at least, seem to be of economic importance in this connection. All of these have been colonized more or less extensively, and three of them have been recovered from the field.

The close of the present year finds us with twice as many species of introduced parasites available for study in the field as we had last year. Instead of being confined to exceedingly limited areas in the vicinity of the original colonies, several of them are scattered over extensive areas, and it is hoped by the continuance of the same and improved methods that this number will be increased during the present year. By a more close following of the increase and spread in the field we may be able to more accurately prophesy upon the probabilities as to the time of the reduction in numbers of the pest than we have heretofore been able to do.

OTHER IMPORTATIONS.

In the last report the successful introduction of a European parasite of the imported elm leaf-beetle was announced. Examinations made at points of colonization during the present summer have failed to indicate that the insect successfully passed the winter. It is possible that it may have established itself in localities unvisited this year, but it has not been as successful as was hoped. Attempts to reimport the species this year have failed, owing to its absence in certain European localities and to the untimely death of Prof. Valery Mayet, of Montpellier, France, occurring at the time when he expected to make shipments to the United States. Through the cooperation of Prof. F. Silvestri, of Portici, Italy, unsuccessful efforts have been made to introduce two other natural enemies of the imported elm leaf-beetle.

European codling-moth larvæ were imported from different parts of Europe, especially from Germany, in considerable quantities during the fall and winter, and the work of rearing them was continued at the gipsy-moth parasite laboratory at Melrose Highlands, Mass. The expert in charge of the work found a very scant percentage of parasitism of the material received, though a large percentage of the larvæ succumbed to the attack of a fungous disease.

EXPORTATIONS OF USEFUL INSECTS.

In my last report I called attention to the fact that while the Bureau desires to return the many favors that foreign entomologists have extended to this country by sending them beneficial insects which may possibly be of service to them, this can be done comparatively rarely, but the occasion has arisen several times, and has justified the attempt.

Mention has previously been made of the exportation of certain important parasites of *Diaspis pentagona*, a scale insect attacking the mulberry in southern Europe, which have been sent to Italian officials, and it is a great pleasure to report the apparent success of one of these exportations. Prof. Antonio Berlese, director of the Royal Station of Agricultural Entomology, at Florence, writing under date of July 10, 1909, informs the Bureau that one of these parasites has already spread through the mulberry trees of Vanzago and has entirely relieved them from the destructive scale. The parasite is now being distributed from this district into other similar localities, and it is Professor Berlese's expectation that in two years relief for all Italy will be effected. Further, it has just been learned that through sendings to Prof. F. Silvestri, of Portici, this parasite has been acclimatized at Acerra, Grottamare, and Palombino, Italy.

During the winter of 1908–9 certain ladybird beetles collected in southern California were sent by the Bureau to Malaga, Spain, for the purpose of preying upon a species of mealy bug. Success has as yet not been reported.

During the summer of 1909 parasites of *Diaspis pentagona* have been sent from Washington to Peru, in an experimental effort to ascertain whether they will successfully parasitize a closely allied scale insect which is greatly damaging the cotton crop in that country.

Other beneficial ladybird beetles have been forwarded by the Bureau to southern Italy, in an effort to acclimatize them as enemies of destructive scale insects.

A new species of tick parasite occurring upon a dog tick in Texas, related to the cattle tick and referred to in a later section of this report, has been sent in considerable numbers to South Africa, in order to ascertain whether it will attack certain congeneric species which are among the most important disease-transmitting ticks in that country.

No further reports have been received as to the success of the exportation of the American sand-digging wasp to Algeria to kill the Tabanid flies which transfer a trypanosome disease of the dromedary, as mentioned in the last annual report of the Bureau. Nor has any further attempt been made during the year to export bumblebees to the Philippine Islands. Dr. P. C. Freer, director of the bureau of science at Manila, states that in April, 1909, descendants of the first importation were found in small numbers in the vicinity of the place where they were liberated in 1908.

WORK ON INSECTS AFFECTING SOUTHERN FIELD CROPS.

The work on insects affecting southern field crops has previously been reported upon in annual reports of the Bureau under different headings and is now, for the sake of convenience, brought together. The whole work has been carried on under the supervision of Mr. W. D. Hunter.

THE MEXICAN COTTON BOLL WEEVIL.

The Mexican cotton boll weevil destroyed at least 400,000 bales of the crop of 1908, of a value of at least $20,000,000. The most noteworthy feature of the situation during the year was the fact that the damage in Texas was light compared to that in Louisiana and in the small portion of the State of Mississippi that had been invaded. Weather conditions in Texas reduced the numbers of the hibernating weevils considerably, but the opportunities for hibernation in the eastern region were so favorable that great numbers survived. Moreover, dry weather during the growing season in Texas retarded the development of the insect, while no such check occurred in Louisiana. Therefore the bulk of the loss fell upon the State of Louisiana. It is perfectly clear that the situation in Texas was abnormal, and that greater damage must be expected whenever the climatic conditions of the winter and spring are more favorable to the weevil. The great loss suffered in Louisiana is a verification of the prediction that has been made by the Bureau of Entomology for several years and indicates the importance of devising means of control adapted to such conditions as are found in Louisiana, Mississippi, and other States that will soon be invaded by the weevil.

Experimental farms.—The general plan of work on the experimental farms that has been followed for several years was continued during the fiscal year. The object of these experimental farms is to apply, under practical field conditions, the results of observations in the laboratory and elsewhere that seem to indicate means of control. New points are being discovered continually. For this reason it is highly desirable to continue the work from year to year. Moreover, in many cases it is necessary to repeat experiments in control through a series of years to determine their relative effectiveness under vicissitudes of different seasons. The experimental-farm work of the Bureau during the fiscal year covered about 300 acres, located at selected points throughout the infested territory.

Utilization of the insect enemies of the boll weevil.—The insect enemies of the boll weevil have come to be of great importance. A large number of examinations were made to determine the mortality rate due to this cause in 1908. It was found in one case that 77 per cent of the boll weevils in a field in Louisiana were being destroyed by their insect enemies. At various points in Texas from 21 to 48 per cent of the weevils were killed in the same way. These records are based on the examinations of many thousands of weevil stages, and indicate the general extent of control brought about by parasites. It is evident that the extent of control secured in this way is much greater than that at the command of the planter by any artificial means. Moreover, it has been found feasible to make certain changes in planting and cultivating systems that will facilitate greatly the work of the enemies of the weevil. Experiments in introduction from one region to another have been made with good success, but it is considered that the most important feature of the parasite situation is to devise means that can be resorted to by the planters to increase their effectiveness. The method of planting, the varieties planted, the spacing of the plants, the methods of cultivation, and the methods of gathering the crop, all have a bearing upon control by parasites. Each one of these features has been investigated and certain recommendations have resulted. The subject is a large and complicated one, dealing with changing conditions, and will require additional work for several years.

In the way of introduction of parasites from one locality into another, encouraging progress has been made. In one experiment the mortality in hanging squares was increased from 9 to 37 per cent by the introduction of parasites from another region. Of course, this experiment was checked by a similar area in which no parasites were introduced. In several cases of this kind parasites that originally did not occur in certain regions were established and in all probability will increase their effectiveness and spread from year to year.

The chain cultivator and other machines for control.—Mention of this device was made in the last annual report. Tests during the season of 1908 demonstrated the effectiveness of the implement. Its use was found to have a practically immediate effect in increasing the death rate of the weevil due to the heat and also indicated great practical value as a cultivator. In fact, it is likely that the use of the implement would be warranted for its cultural effect even if no weevils were destroyed. The implement was examined carefully by the president of one of the large manufacturing concerns of the country. As a result the company has manufactured a number of machines that have been placed upon the market.

It was discovered during the season that an implement constructed on the principle of the chain cultivator, but with runners of wood instead of chains, might also have an important effect in the control of the weevil. In fact, the wooden implement will probably be found better adapted to some conditions than the chain cultivator.

Special studies in the Mississippi Delta.—For some years the greatest damage by the boll weevil will undoubtedly occur in the States bordering on the Mississippi River. The first season after the original invasion by the weevil in that region has frequently shown a falling off of 50 per cent in the crop. This is much more than the damage done under similar conditions in Texas. The causes for this situation are the precipitation, presence of heavy timber, mild winters, and other features. These all combine to give the boll-weevil problem more serious features than it has had elsewhere. This prediction of special damage was made several years ago by the Bureau of Entomology, and the findings in the delta region during the last year have demonstrated fully that the danger was not overestimated.

One of the most hopeful features in the delta region is a utilization of parasites, but all other means of control must be taken into consideration. For this reason special experiments and observations were made on the life history of the weevil in the Delta. This included experiments in hibernation in the neighborhood of Natchez, Miss. The work in this case was planned primarily to determine what may be accomplished by the destruction of plants at different dates. It is the general impression of planters in the Delta that the destruction of plants will not be as effective as in Texas.

Work on status of weevil.—There is a regular and proper demand for information regarding the status of the weevil and the amount of damage that may be expected. It devolves upon the Bureau of Entomology to furnish this information. To do so requires the examination of many cotton fields at different times during the season, the comparison of the records with those of previous years, and the dissemination of the data thus obtained. This work was continued during the year.

General laboratory work.—In the laboratory of the boll-weevil investigation at Dallas, Tex., many experiments were conducted that were later carried into the field. In fact, whenever anything is discovered in the laboratory in the study of the life history of the weevil or its parasites that furnishes a clew to control, the matter is immediately taken up under practical field conditions. The life history of the weevil is now pretty well understood; therefore the principal work during the season was in connection with the propagation of parasites. In addition, of course, the records of all the experiments outside of the laboratory were kept there, and large numbers of parasites were studied, reared, and disseminated.

Testing proposed remedies.—Many persons continue to offer suggestions about the control of the weevil. These frequently take the form of special preparations, such as poisons. It was necessary, therefore, during the fiscal year to make a number of tests for the information of interested parties and to guard against the extensive sale of useless substances.

Isolated colonies.—As in other years, a constant effort was made to locate isolated colonies far enough ahead of the general invasion to warrant the undertaking of eradication. This was done through field trips and by correspondence with state authorities and others.

TOBACCO INSECTS.

The work on tobacco insects, begun last year and reported upon in the last annual report, has been continued during the year. The main work was carried on in the dark-tobacco region of Kentucky and Tennessee, with headquarters at Clarksville, Tenn. In this region the damage done by injurious insects to the tobacco crop of 1908 is estimated to have amounted to more than $500,000. The work here was pursued under four main heads: (1) Life history and seasonal studies of the different injurious species; (2) studies of native parasites with a view of increasing their usefulness, and importations of egg parasites of the so-called hornworm from Porto Rico; (3) experiments relating to methods of control; (4) demonstrations of remedies. Under the first heading many important data have been gathered, but the greater time of the investigators has been given to the tobacco hornworms and the flea-beetles, which are the most important pests. It has been found that a spray of arsenate of lead, at the rate of 1 pound of the paste or one-half pound of the powder to 12 gallons of water, is an effective remedy against flea-beetles and also against all other insects attacking tobacco in the plant bed. Paris green at the rate of from 1 to 2 pounds per acre has been found to be effective against the larvæ of the hornworms, but injury to the foliage following this treatment has been reported and experiments with other arsenicals have been undertaken in order to prevent this damage.

Trap cages placed over the flowers of jimson weed were found to capture numbers of moths of the tobacco worm. Fall plowing of land that has been in tobacco during the preceding summer has been shown to destroy 39 per cent of the pupæ of the hornworm that would otherwise hibernate successfully. Cooperative demonstrations of remedies were made at Clarksville, Tenn., and Guthrie and Hopkinsville, Ky.

Additional work was done in Virginia, and during the fall of 1908 a preliminary survey was made at Appomattox, in that State, of damage to tobacco reported to be due to a wireworm. The damage was estimated at $800,000 for the dark-tobacco district of Virginia. It was shown that the injurious insect is a species of Crambus, and an investigation of its life history has been begun.

Although the Bureau had at an earlier date made an investigation of the tobacco thrips in Florida, reports of great damage by planters in Florida brought about a preliminary resurvey during March, 1909. An expert was sent to Florida and visited many growers of shade tobacco at Quincy, and also made collections of thrips to find, if possible, the native food plants and hibernating quarters. From the experiments made it seems possible that the tobacco thrips has a long hibernating period under ground, like the pear thrips, and if this should prove to be the case the problem of control will be difficult.

During the year, at the request of the tobacco journals, it was decided to make a special investigation of the so-called cigarette beetle. Circular letters of inquiry were sent out during the winter to tobacco manufacturers, and much information was gained. One successful demonstration of carbon bisulphid as a fumigant against this insect was carried on.

OTHER INVESTIGATIONS.

As pointed out in the last report, insects have been found to be an important obstacle to the cultivation of cactus as a farm crop. During the past season it has been found that the damage to the planted cactus has not been overestimated, but that means of control can be put into operation in an economical way. Certain species can readily be trapped in hibernation and burned, and others may be burned upon the plants by the use of torches such as are used in removing the spines, and others may be controlled in other ways. The investigation has practically been completed. Some points require additional study the present season, but it is hoped that the work can be reported upon finally within the next fiscal year.

The necessity for further work upon the insect enemies of sugar cane and rice, as well as upon the so-called Argentine ant, has been forced upon the Bureau, and toward the close of the fiscal year arrangements were made to begin systematic work upon these pests, beginning with the first of July, 1909. These investigations will be outlined later in this report.

INVESTIGATIONS OF INSECTS DAMAGING FORESTS.

The investigations of insects damaging forests, carried on under the direction of Dr. A. D. Hopkins, have been restricted during the past fiscal year more than formerly to the various sections of the country where there seemed to be the greatest need for the work. The more important field investigations of the year have related to the following subjects:

THE WHITE PINE TWIG BLIGHT.

Investigations were carried on in New Hampshire, Maine, and adjoining States, to determine the relation of insects to the several forms of twig blight of the white pine, and incidentally a number of other forest-insect problems peculiar to the New England States were investigated. This has resulted in the determination of some of the causes of the twig blight and the accumulation of many new facts of systematic and economic importance.

INJURIES BY INSECTS TO STORM-FELLED TIMBER.

Investigations were continued in Mississippi and Arkansas on the relation of wood-boring insects to subsequent damage to storm-felled pine timber in the Southern States. This has resulted in the accumulation of evidence to indicate that the storm-felled timber in Mississippi, Louisiana, Alabama, and Arkansas, resulting from the great storms of 1906, 1907, and 1908, amounted to over 2,000,000,000 feet, board measure, and that during the period in which the timber was sound enough for lumber it was reduced in value 25 per cent by wood-boring insects. It has also been determined that a large percentage of this loss can be prevented, now that the essential details in the habits of the insects are known.

INSECT DEPREDATIONS IN PRIVATE FORESTS.

Investigations were continued in the private forests of northern California during the summer of 1908 and winter of 1909, in which much new and valuable information was accumulated and on which special recommendations to the owners were based, but further progress toward securing the desired practical demonstrations was prevented by unforeseen personal troubles affecting the field agent in charge of the work.

SULPHUR-FUME INJURY AND INSECTS.

A special investigation was made of the relation of injury by sulphur fumes to previous and subsequent injury by barkbeetles to the timber on private and other lands in the vicinity of Anaconda, Mont., resulting in the conclusion that such relations were of little or no economic importance.

PRACTICAL DEMONSTRATION WORK.

Investigations relating to practical control have been continued in the national and private forests of the central Rocky Mountain region. Special attention has been directed to the securing of statistical data and to the concentration of the cooperative efforts of the Bureau of Entomology and the Forest Service on securing the proper application of the recommendations of this Bureau for the control of extensive depredations by the Black Hills beetle, so as to furnish forcible and convincing demonstrations of the practicability of such control. In all of this work marked success has been attained.

INSECT DAMAGE TO HARDWOOD PRODUCTS.

Investigations of the insects damaging hardwood products and practical demonstration work in their control have been continued, principally in direct cooperation with the more extensive operations in the manufacture of handles, agricultural machinery, vehicles, army and navy stores, etc., and most gratifying progress has been made.

COOPERATION.

Forest entomology and forestry.—The cooperation between the Branch of Forest Insect Investigations of this Bureau and the Branch of Silviculture of the Forest Service comprises the investigation of practical methods of insect control and efforts toward securing the proper practical application of available technical and other information on the insects and local forest conditions in the inauguration of policies of insect control in the various National Forests of the country.

The feature in this cooperation which has yielded most satisfactory results is that in which the Branch of Silviculture furnishes an experienced forest ranger to work under immediate instructions from the forest entomologist in charge of the Branch of Forest Insect Investigations in the location and marking of beetle-infested trees and in securing information on practical and local details to supplement the final recommendations by the forest entomologist for the practical control operations which are conducted by the local forest official under the supervision of the insect-control ranger.

Forest entomology and forest pathology.—While there is no cooperative agreement between the Laboratory of Forest Pathology, of the Bureau of Plant Industry, and the Branch of Forest Insect Investigations, there is a most congenial and helpful interchange of ideas and suggestions, and some cooperative investigations on subjects and problems involving the intimate interrelation of insects and fungi.

Forest entomology and private interests.—A most promising cooperative arrangement for the attainment of immediate practical results from the proper and most economical application of expert information in forest insects and the prevention of losses from their ravages has been effected with certain manufacturers of forest products, in which the company furnishes a thoroughly practical man (who is familiar with the details of manufacturing, handling, storing, and finishing the products that are subject to damage by insects) to work under immediate instructions from the forest entomologist in the conducting of all insect-control and experimental operations that involve, as essential features for their success, a technical knowledge of the insects. In other words, all questions relating to the insects and the essential details on methods of control are decided by the entomologist, and all questions relating to the adjustment of business methods and to local conditions and requirements favorable or otherwise for the practical application of any part or all of the recommendations are decided by the representative of the company. When an agreement is reached all of the expenses of the experiments and practical application in control work are borne by the company.

Cooperation in control demonstrations.—During the latter part of the year certain combinations of circumstances and subsequent information secured through this Bureau led to the activity of a resident of Montana (Mr. Josef Brunner) in calling public attention, through the press, correspondence, and otherwise, to the extensive depredations by barkbeetles in the vicinity of Pine Grove, Mont., and to the need of prompt action under the advice of the Bureau of Entomology. The infestation involved timber on private and state lands, the national forests, and the public domain. This combination of interests, with requests for information and action on the part of the Government, coming from state officials, including both Senators and the Representative, and from a prominent commercial club, presented at once a most interesting and complex situation in which it was plain that nothing whatever could be accomplished without definitely organized effort. Therefore Mr. Brunner was appointed by the Secretary of Agriculture as an agent of this Bureau, to work under our immediate instructions. Mr. Brunner proceeded at once to locate and mark the infested trees and to estimate the cost of the required control operations. He reported that 1,000 infested trees had been located on private and state lands and 100 on the national forest, and that it would cost approximately 30 cents per tree to cut and bark them to kill the insects. Upon receipt of this report, propositions were made to the Forest Service, state officials, and the commercial club that an agent of this Bureau was ready to proceed with control operations if the required money to cover the actual cost of the operations was provided. The Forest Service promptly appropriated $100 to cut and bark the infested timber on the national forests. After some delay and the loss of precious time, the parties in charge of the state and private interests indicated their willingness to provide the necessary funds, and at the latest practicable date the control work was started with good prospects for its completion in time to destroy the insects before they emerged to extend their depredations in the remaining living timber.

Whether or not this particular effort succeeds and serves its primary object of demonstration, it opens up new and most promising possibilities for further action along similar lines of direct cooperation between this Bureau and national, state, and private interests, either individually or combined, in securing the desired examples of practical and effectual control through the prompt adoption of the proper and inexpensive methods of procedure. Therefore it should be extended to the full limit of the funds and men available for such demonstration control work.

Forest entomology and state forestry.—The last piece of work of the year related to the consideration of plans for cooperation with a state entomologist in a survey of the State, to determine the principal insect enemies of the forest trees and the character and extent of the damage, in which the State furnishes an assistant to work under our immediate instructions, subject to the approval of the state entomologist. The results are to be published by the State, under joint authorship. This seems to open up another field of opportunity and usefulness in survey and practical control work, by which a State, through the expenditure of a comparatively small sum of money, can secure authoritative advice based on extensive investigation of national and interstate problems, and by which at the same time this Bureau will be afforded exceptional opportunities to disseminate information and make practical demonstrations which will contribute to one of the desired ends, viz, a more general recognition of the importance of the subject and the practicability of preventing losses.

PRACTICAL RESULTS.

Control of the Black Hills beetle.—The permanent value of the successful efforts to control the Black Hills beetle in the vicinity of Colorado Springs and on an extensive private estate in southern Colorado, mentioned in the 1908 report, have been verified by observations during the past year, which failed to reveal any evidence of new infestations.

The practicability of controlling this most destructive enemy of the pine timber of the central Rocky Mountain region, not only without ultimate cost but at a profit on the first cost of the operations, has been demonstrated during the past year on a large private estate and the adjoining Pike National Forest, in north-central Colorado. An examination of the timber in the spring of 1907 by the ranger detailed from the Forest Service to work under our instructions showed that the depredations by the beetles had been going on for the past ten to fifteen years or more, and had resulted in the death of more than 800,000 board feet of the finest timber. About 65,000 board feet of timber was found to be infested by the beetle at the time of the examination. The owner was notified of the dangerous character of the infestation and the required action recommended to control it, but no action was taken. Another examination of the property was made in the fall of 1907, when it was found that the new infestation resulting from swarms of beetles that had been allowed to emerge from the old infested trees involved nearly four times as much timber, or 240,000 board feet. This alarming increase led to the prompt adoption of our recommendations by the owner and the Forest Service, and by May of the following spring (1908) the small number of trees on the national forest were cut and barked, to kill the insects in the inner bark, and the thousand or more trees on the private estate were felled, the logs converted into lumber, and the slabs burned, which accomplished the desired purpose of destroying the broods of the beetle. The owner realized a sufficient revenue from the timber thus involved to cover all expenses and leave a net profit of over $1,200. Examination of the area in the fall of 1908 showed that this prompt and properly conducted effort to control the beetle was a complete success. Thus the average death rate of some 100,000 feet of timber annually during the past ten or more years was reduced to a minimum, at a net profit on the cost of doing it.

The cash value of this result, as based on present and future stumpage value of the living timber thus protected in the private and national forests of the entire area coming under the influence of such control operations, is evidently not less than $50,000, and its value as a demonstration of the absolutely practical and inexpensive method of controlling an extensive invasion of the Black Hills beetle should be worth far more than the cost of forest-insect investigations during the past ten years.

Profiting by the results attained in the control of this beetle in private forests, special efforts have been directed to its control in the Las Animas National Forest and the Wet Mountain section of the San Isabel National Forest, both of which have suffered so severely from its ravages that it is estimated that more than 3,000,000 board feet of merchantable pine has been killed during the past ten years, or an average of about 300,000 feet per year. In addition to infested trees disposed of by the Forest Service in timber sales, 165 infested trees in one section of the Las Animas were cut and barked in May and June, 1908, at a direct cost of $177.50, and at the same time a considerable amount of infested timber was disposed of by sale in the Wet Mountains. This had a decided effect in checking the ravages of the beetle, and it was followed up the next spring (1909) by the proper disposal of over 1,300 infested trees by free use, ranger labor, and direct expenditure of funds appropriated by the Forest Service. Therefore, the thorough and proper manner in which our instructions were carried out in this case will evidently bring the beetle under complete control, effectually protect the remaining living timber, and, what is more important, serve as an example of the necessity and practicability of insect control in the National Forests.

Control of the mountain pine beetle.—It is evident that if the necessary funds are made available and the extra force of men can be secured to fell and bark the thousand or more trees in the vicinity of Pine Grove, Mont., infested with this near relative of the Black Hills beetle, an equally destructive enemy of the pine timber will be brought under complete control, and this will serve as another demonstration of the possibility of attaining the desired control under an exceptional combination of difficulties.

Progress in the control of powder-post beetles.—The direct answer to a series of questions sent to principal correspondents of this Bureau who have requested information during the past six years on methods of preventing losses from powder post show conclusively that in the numerous cases where our recommendations have been properly carried out most gratifying results have been attained, thus demonstrating the value of such recommendations in actual practice.

INVESTIGATIONS OF INSECTS DAMAGING DECIDUOUS FRUIT TREES.

The investigations of the Bureau against the group of insects damaging deciduous fruit trees have been carried on under the direction of Mr. A. L. Quaintance, and have covered a wide field.

THE PEAR THRIPS.

The investigation of the pear thrips, begun July 1, 1907, soon bid fair to prove one of the most important pieces of work carried on by the Bureau. The damage already accomplished was very great, and that threatened was excessive. While the infested territory is at the present time included within a radius of about 100 miles from San Francisco, the character of the damage is great and the spread of the insect is practically certain. The immediate necessity for competent remedies is striking. Full studies of the life history of the insect have been made and large-scale experiments in all directions have been carried out. The possible value of applications of fertilizers and of soil fumigation, irrigation, etc., to bring about the destruction of the insects in the soil has been investigated without important practical results. Experiments in deep plowing of the soil during the summer to destroy the larvæ, which at this period are all beneath the surface of the ground, gave practically negative results, since the larvæ are active at this period and are quickly able to reconstruct new cells, in which they will live undisturbed. In the autumn, however, it was discovered that deep plowing and cross-plowing with harrowing after the first rains are remarkably effective. At this time the insects are mostly in the helpless pupal stage and are very susceptible to any disturbance. In two orchards in the Santa Clara Valley, where this method was thoroughly tried, there were killed, respectively, 70 and 73 per cent of the insects. Moreover, this process, in addition to its great value in destroying the thrips, is very beneficial, since it puts the soil in better condition to retain water from the winter rains and brings about a more vigorous condition of the trees.

In addition to this excellent result, spraying tests in the spring of 1909 resulted in the discovery that a combination of a tobacco extract in the proportion of 1 to 60 of water with 2 per cent of the distillate oil emulsion produces a perfectly satisfactory spray of excellent penetrating qualities which kills practically all of the thrips which it touches without any injury whatever to the trees.

Extensive experiments were carried on in the Santa Clara Valley and in the Ignacio and San Ramon valleys in Contra Costa County. Through the material cooperation of the authorities in the counties mentioned, and also that of orchardists, it was possible to conduct the work on a much larger scale than would otherwise have been possible.

It seems that the adults of the pear thrips are for the most part out of the ground and congregated upon the trees before the blossoms have opened to any extent, and it was found that one or two thorough applications of the spray mentioned, under high pressure and directed downward to force the liquid into the bud clusters, will destroy a great majority of the insects present. Careful estimates of the results of this work place the percentage of thrips thus killed at from 90 to 97.

The long period between the swelling of the buds and the actual opening of the flowers in California greatly favors the work of spraying. After the petals of the flowers have spread the insects work inside and are protected.

The spraying operations in both counties were uniformly favorable, and resulted in protecting the blossoms and insuring a fruit crop in orchards in which for some years the crop had been destroyed by the thrips. Several orchardists, acting under the instructions of the Bureau's agents, obtained very satisfactory results, and have expressed full confidence in the entire efficiency of sprays and the method of cultivation described as remedies for the thrips. The use of either or, preferably, both methods in conjunction should give a large degree of freedom from further injury.

In September, 1908, the writer visited California and found the fruit growers practically in despair. One large orchardist expressed himself as confident that nothing could be done and was cutting down a large portion of an orchard valued at $250,000. The matter had been called to the attention of the State Board of Trade, and the utmost anxiety was felt over the probable spread of the insect, not only throughout all the fruit-growing regions of California, but to the more northern Pacific States, and ultimately toward the East. As the result of two years' work the Bureau feels that the problem is solved, and it only remains to conduct some additional demonstrations and to carry out a few additional experiments before the problem can safely be left to the orchardists themselves. Much credit should be given to the boards of supervisors of Santa Clara and Contra Costa counties for financial assistance in both experimental and demonstration work, and to individual orchardists for cooperation in the use of their orchards.

CRANBERRY INSECTS.

As pointed out in the last annual report, the methods of control of cranberry insects which were more or less satisfactory in the cranberry bogs of New Jersey and Massachusetts were not effective in the bogs of Wisconsin, and cooperative work between the Bureau of Entomology and the University of Wisconsin had been instituted. This work during the past fiscal year has been continued and enlarged. Owing to local conditions which render flooding of questionable safety, especially in midsummer, attention has largely been given to sprays. The cranberry fruit worm is at present by far the most serious pest in the State, and destroyed last year about 30 per cent of the crop, while in certain bogs from 50 to 65, and even 95, per cent was destroyed. Effective spraying can be practiced only on bogs reasonably clean of grass and weeds, and it has thus been necessary to give attention to the subject of cultural methods. Large-scale spraying demonstration experiments have been carried out in different portions of the cranberry marshes in the Cranmoor district, and have shown uniformly a considerable benefit. Combination sprays of Bordeaux mixture and arsenate of lead have reduced injury by the fruit worm from 60 to 14 per cent. This would be equivalent to a money gain, based on average yield and price, of $86 an acre. In the spring of 1909 it was planned to do more spraying than last year, in cooperation with cranberry growers, who would provide for a considerable portion of the expense.

THE CODLING MOTH.

Of late much interest has been shown in the one-spray method advocated in the Northwest against the codling moth as applied to the usual schedule of applications followed by eastern orchardists. During the season of 1909 an effort has been made to secure all of the conditions necessary for one-spray work, and tests are being made in Virginia, Michigan, Arkansas, and Missouri to secure data from representative fruit regions as to the effect of variable climatic and other conditions. It is too early as yet to report results.

Extensive experiments were made during the summer of 1908 in the Ozarks, in cooperation with the Missouri State Fruit Experiment Station and the Bureau of Plant Industry of this Department, to determine the relative merits, in the control of insects and fungous diseases of the apple, of liquid and dust sprays. The dust sprays are much in use in the Middle West, although a great difference of opinion prevails as to their value. The result of the summer's work indicated a great superiority in liquid sprays, although some points investigated need confirmation, which is being obtained during the summer of 1909.

Demonstration spraying for the codling moth and apple diseases has been carried on in cooperation with the Bureau of Plant Industry in orchards in Arkansas, Virginia, Michigan, and western Missouri. The demonstration spraying in progress last season in southeastern Nebraska was successfully concluded, exact records being kept of the cost of the operations and the benefit in money as a result. A net gain of spraying of from $2 to $5 per tree resulted, and this is considered to be very favorable.

Further observations have been carried on in relation to the work of the codling moth in pears. Since the calyx lobes of pears do not close as they do with apples, certain differences in treatment are necessary, and spraying experiments have been carried on, at the request and in cooperation with pear growers in California, to determine the practical effect of these differences, and agents are also at the same time making life-history observations as possibly showing the necessity for differences in treatment.

THE GRAPE ROOT-WORM.

The work on the grape root-worm, begun in the spring of 1907, has been continued in the Erie grape belt, with headquarters at North East, Pa., in cooperation with the state department of agriculture of Pennsylvania. It has been shown to be practicable to protect young vineyards from further injury by a system of spraying and cultivation and also by the schedule of treatment which includes pruning, cultivation, spraying, and the use of fertilizers, to restore to excellent bearing condition old vineyards so badly injured by the root-worm as to become unprofitable.

ARSENIC ACCUMULATION IN SOILS IN SPRAYED WOODLANDS, ORCHARDS, AND VINEYARDS.

The dying of orchard trees in certain portions of Colorado has recently been stated to result from the accumulation in the soil of arsenic following spraying, the arsenic becoming soluble and injurious to the trees by reason of alkali present in the water. The danger of similar injury under eastern conditions has, in consequence, been more or less agitated, especially in connection with the use of excessive strengths of arsenate of lead in the control of the brown-tail and gipsy moths. The question of danger of injury to orchard trees has also been raised. The importance of the matter warranted an immediate investigation, which has been undertaken in cooperation with the Bureau of Chemistry. Soil samples have been obtained and referred to the Bureau of Chemistry from woodlands in the vicinity of Boston, and from orchards in western New York, Illinois, Arkansas, and Virginia, and from vineyards in Erie County, Pa.

INSECTICIDE INVESTIGATIONS.

The increasing use of self-boiled lime-sulphur wash as a fungicide in place of Bordeaux mixture, especially on apple, has called for information as to the safety to foliage and efficiency of arsenicals when added to this preparation to effect a combination treatment for insects and diseases, as has been done for many years in the case of arsenicals and Bordeaux mixture. In cooperation with the Bureau of Plant Industry, numerous experiments have been made by adding to the self-boiled and commercial sulphur washes both arsenate of lead and Paris green in the usual quantities for orchard work. The tests made and in progress during the season of 1909 indicate that arsenate of lead may be safely used in the self-boiled wash on apple, and that it is not more injurious to peach foliage or fruit than when applied alone. While important chemical changes undoubtedly take place upon the addition of the arsenate of lead to the wash, as shown by a decided change in color, no injurious by-products apparently are formed. In the case of commercial sulphur solutions some injury has been noted. Also injury to foliage has resulted where Paris green was employed, though perhaps not more so than when this arsenical was used alone. In the course of these tests the self-boiled wash has been found to be very destructive to plant-lice infesting the apple and other plants, and equal in effectiveness to other insecticides commonly used against this class of insects. The tests with self-boiled lime-sulphur wash as a summer treatment for the San Jose scale mentioned in my last report showed that even very badly infested trees could be largely freed from the insects by the two or three necessary sprayings employed in controlling fungous diseases. It therefore seems probable that, in addition to being an excellent and safe fungicide, as has been shown by the Bureau of Plant Industry, when so used on trees in foliage it will at the same time control scale insects and plant-lice, and by the addition of arsenate of lead will also act to control fruit and leaf feeding insects. The range of usefulness of this wash as a fungicide and insecticide clearly indicates that it will at once come into extended use.

FRUIT-TREE BARKBEETLES.

The investigation of fruit-tree barkbeetles in cooperation with the Ohio Agricultural Experiment Station, with headquarters at Lakeside, Ohio, was continued to the close of the growing season of 1908, and a preliminary report (Part IX of Bul. 68) was issued. The authorities of the Ohio Agricultural Experiment Station, while desirous of continuing the cooperative agreement for the season of 1910, were at the same time in position to carry out the work unaided by the Bureau, and consequently this work was closed, so far as the Bureau is concerned.

CEREAL AND FORAGE-PLANT INSECT INVESTIGATIONS.

As during the last year, the work of the section of cereal and forage-plant insect investigations of the Bureau, in charge of Mr. F. M. Webster, has been devoted largely to the so-called "green bug," the jointworms, and the Hessian fly, but new subjects demanding investigation have arisen, and the past fiscal year has been one of hard work and good results.

THE SO-CALLED "GREEN BUG" AND ITS PARASITES.

The so-called "green bug" was so greatly reduced in numbers by its natural enemies in 1907 that it was practically absent from most of its range until the late summer and early autumn of 1908. Its native food plants have been studied and twenty-five species have been found, on many of which it can feed as on grain, these constituting alternative food plants. The life history of the species has been followed continuously through two years, and the conditions have been ascertained which facilitate its increase with the greatest rapidity. A number of new parasites have been found and the habits of the principal species have been studied with great care, and the knowledge has been gained of just when and under what conditions these parasites can be depended upon to prevent an invasion of the green bug and what the farmer must do himself to ward off or reduce the severity of the invasion. The temperature of the winter of 1908–9 was favorable for the development of the pest, and the abnormally low temperature in the spring of 1909 gave the insect a chance to increase in numbers, so that during the late spring there were local injuries in western North Carolina, northern Georgia, southern Oklahoma, and southeastern New Mexico. The investigations of these local outbreaks have shown that the farmer can do much to protect himself by preventing the growth of volunteer grain in fields intended for fall wheat or oats and by delaying the sowing of these crops as late in fall as possible. The object is to prevent the pest from becoming established in the fields until a late date in the fall. This reduces the period during which the growing grain may be attacked and prevents the increase of the green bug to the destructive point before its natural enemies arrest it in the spring. Should the pest, however, become established in the field early in the autumn its work will first be observed in spots, and these spots can be treated effectually by kerosene emulsion or by the whale-oil soap mixture, or they can be plowed under and the surface of the ground rolled, or straw can be scattered over the spots and burned.

It seems unlikely that the farmer himself will be able to determine whether his crop is threatened. The insect is so minute, so secluded in its habits, and resembles other plant-lice so much that it requires competent entomologists to constantly watch the status. This should be done by employees of the Bureau and of the different States involved, in cooperation.

WORK ON JOINTWORMS.

Careful studies in the Northwest of damage by the wheat strawworm have indicated that damage from its ravages can be prevented by cultural methods. Its injury is induced by growing crops of winter wheat repeatedly upon the same land; by leaving volunteer plants among the spring wheat; by allowing the summer fallow to grow foul with volunteer wheat, even at a distance from wheat fields, and by growing spring wheat near winter wheat. The remedy lies in avoiding these conditions by rotation of crops, clean early summer fallow, and the abandonment of spring-wheat culture in infested regions.

A serious outbreak of the true joint-worm in Ohio, Indiana, and Illinois has occurred. Information is accumulating which goes to show that late seeding of wheat in connection with rotation of crops tends to reduce its injuries.

HESSIAN FLY INVESTIGATIONS.

In 1908 there was an outbreak of the Hessian fly in southern Kansas, which was so severe that many fields were left unharvested. Fortunately, three series of wheat-sowing experiments had been established by the Bureau in the fall of 1907 in Kansas, and two of these were within the area of severest destruction by the fly in 1908. In this way the Bureau had exact data to work upon both preceding and during the outbreak. The immunity of wheat sown after certain dates in the fall of 1907 was so apparent that a campaign of late sowing, based on these results, was instituted and followed up by the experiment station, the agricultural press, the millers, the grain dealers, and, in one instance, by a church organization. As a result the crop of 1909 practically escaped attack, the parasites, and particularly the species introduced by the Bureau from Pennsylvania, having apparently overcome the pest in those instances where its numbers were increased by volunteer and early sown wheat. At the prevailing price of wheat during 1908 and 1909 it is a safe estimate that the wheat-sowing experiments in Kansas resulted in the saving of $500,000 or more. The investigations on this insect will be continued, and will include work in transporting parasites and establishing them on the Pacific Coast and elsewhere.

OTHER INVESTIGATIONS.

The slender seed-corn ground-beetle has been studied for two years. Under-drainage, rotation of crops, and late planting have been found to afford almost perfect control of the pest.

The investigations on the southern corn root-worm have been continued with gratifying results, and practical preventive measures seem to be in sight.

The southern corn leaf-beetle is being studied by an agent, and careful investigations are being made of the sorghum seed midge, since planters of the South are unable to grow sorghum seed on account of the ravages of this insect.

A most unusual and serious state of affairs has been found to exist in northeastern New Mexico, where the larva of a large moth of the genus Hemileuca has been attacking the grama grass on the cattle ranges in increasing numbers and over continually widening areas. Hundreds of acres were ravaged last year, leaving the ground as bare as if it had been burned over. In October and early November the moths swarmed over the country miles from their place of origin and deposited their eggs in millions. The pest bids fair to render many square miles of range absolutely worthless for grazing. These insects are being carefully investigated by the Bureau.

Other insects now being studied are the corn root-aphis, the cowpea curculio, a new wheat enemy in New Mexico of the genus Meromyza, alfalfa insects, a corn leaf-miner, clover insects on the Pacific Coast, grasshopper outbreaks and their control, and other outbreaks.

WORK ON INSECTS INJURIOUS TO VEGETABLE CROPS.

The widened scope of work on insects injurious to vegetable crops, under the direction of Dr. F. H. Chittenden, has made possible more satisfactory results than heretofore. The reasons for the establishment of stations to study these insects were given in the last annual report.

INVESTIGATIONS IN TIDEWATER VIRGINIA.

The Bureau was continuously at work in 1908 in cooperation with the Virginia Truck Experiment Station and a produce company of Norfolk, Va., upon the insects damaging the truck crops of that region, the total value of which is estimated to amount to $15,000,000. The principal insects studied were spinach and cabbage plant-lice, the Colorado potato beetle, the striped cucumber beetle, the onion thrips, the bean leaf-beetle, the pea aphis, the cabbage webworm, and some others. Field work on a large scale with different remedies was carried out, and it was demonstrated that with the majority of these species control is easy and economical.

WORK IN SOUTHERN TEXAS.

The same class of work has been carried on in southern Texas as in previous years. The insects under special investigation have been the melon aphis, the onion thrips, some beetles closely related to the northern cucumber beetles, corn root-worms, certain forms of beetles injurious to potato, several flea-beetles, including a new enemy of beets, the southern cabbage butterfly, and certain species of leaf-hoppers, and a number of injurious caterpillars, including the imported cabbage webworm. Extensive work has been done on a number of these species, many of which have not been previously investigated.

The insect enemies and parasites of a number of species of plant-lice have been studied, and there is some promise of interchange of species of beneficial parasitic and predaceous insects to act as destroyers of the melon aphis.

WORK IN FLORIDA.

The principal subject of investigation in Florida has been the tomato fruit-worm, or corn earworm, with especial reference to its control on tomato. It was ascertained that the most successful means of fighting injury by this insect is to plant early and also to make several successive plantings of corn in the tomato fields, so that in the last five weeks of the growing season there will be a supply of corn silk to attract the moths to lay their eggs. This draws them from the tomato and is a practical point of some importance.

The pickle and melon worms were also studied, and work on their life histories was completed. For the melon worm, arsenate of lead has been found to be the best method of control. This is sprayed upon the foliage for the earlier generations, and is not dangerous to melon eaters.

OTHER WORK.

Further investigations have been made in the principal sugar-beet regions in southern California, where two species of plant-lice affecting the beet roots, the beet leaf-miner, certain flea-beetles, and other insects are doing considerable damage.

In addition to these distinct pieces of work, a general survey of truck-crop insects the country over has been kept up, and studies have been made of numbers of the most important species.

An interesting development of the year has been the finding of a parasite of the eggs of asparagus beetles in New England. This parasite on one farm developed to such an extent as to render the employment of artificial remedies unnecessary, resulting in the saving to this farm of about $200, which would otherwise have been expended in insecticides and labor. This parasite is under investigation by the Massachusetts experiment station and by the Bureau with a view to its possible introduction into other localities.

WORK ON INSECTS AFFECTING CITRUS FRUITS.

Work on insects affecting citrus fruits has been carried on during the year under the direct supervision of Mr. C. L. Marlatt. The principal items have been a continuance of the white-fly investigations, work on the hydrocyanic-acid gas fumigation in California, and work upon the orange thrips, also in California.

WORK ON THE WHITE FLY.

The investigation of the white fly in Florida has been continued with the view of placing every practicable line of control on the best possible basis. The decrease in profits from citrus culture in Florida during the last two years has emphasized the necessity for a most exhaustive study of all phases of the subject, so that advantage may be taken of every factor which may aid in reducing the expense of control to a minimum. During the fiscal year ending June 30, 1909, life-history studies and fumigation experiments were practically concluded, experiments with contact insecticides were taken up again after having been discontinued temporarily to allow the conclusion of the more important fumigation experiments, experiments with the fungous parasites were continued with much progress in determining their degree of usefulness, and the study of trap foods has been taken up as a new project.

It proved desirable to carry certain lines of life-history studies of the citrus white fly through another year in order to cover a wider range of conditions. The discovery of the existence of another injurious species of white fly on citrus trees in Florida has made necessary a comparative study of its life history, economic importance, and control. Fortunately, this second species is of limited distribution, has no other known food plants than citrus, and is more easily controlled. It has been found that where it occurs in the same tangerine or orange grove with the citrus white fly (*Aleyrodes citri* R. & H.) it assumes a position of relative insignificance.

Fumigation experiments were conducted on a large scale in cooperation with several orange growers. The main object has been to determine to what extent this process may be used, without regard to the white-fly situation in neighboring groves, by citrus growers whose groves are not isolated. In addition, extensive experiments have been conducted in fumigating nursery trees, which will be of great value to nurserymen and to orange growers with newly planted groves. The new process of estimating the dosage referred to in the last report has been used by previously inexperienced citrus growers with success, as was predicted. This process, consisting of a specially marked tent for use in connection with a new form of dosage table adaptable for use against any insect, has been introduced into California and made the basis of an improvement in the old system of fumigation in that State.

An extensive series of experiments has been conducted to determine the efficiency, cost, and the effect on citrus foliage of each of the many contact insecticides in use against the white fly. The time required for work in progress in other lines did not permit the completion of all spraying experiments as planned. There remains for completion a thorough study of the methods of application. The type of spray nozzle, its discharge capacity, pressure required for best results, and amount of spray per tree are the important points in this connection.

The experiments with the fungous parasites have resulted in acquiring very extensive data which appear to lead to the conclusion that has been arrived at in connection with fungous diseases of the chinch bug, i. e., that the successful development and spread of the fungous growths are too dependent upon weather conditions for reliance to be placed upon them, even with the best methods of artificial dissemination of the spores. There is a great deal of misinformation current among Florida citrus growers in regard to the efficacy of the fungous parasites, requiring conclusions in this line to be supported by data of the most convincing kind. One species of fungus which has been considered by other investigators as a parasite of the white fly has been proved to be principally saprophytic, rarely, if ever, developing on living insects. It is expected that final conclusions in regard to the known species of fungous parasites of the white fly will be reached by the end of the calendar year.

The investigation of the usefulness of trap foods includes practical field experiments in the pruning of citrus water-shoots at advantageous times and studies of the attractiveness to adult citrus white flies of various non fruit-producing food plants. The pruning of water-shoots has been found to be a very important factor in the control of *Aleyrodes nubifera* under some conditions, and the work now in progress aims to show the limits of its usefulness. The citrus white fly, on the other hand, is not so greatly affected by the removal of water-shoots, but its attraction to china and umbrella trees, as compared with citrus trees, during the time of flight of the first two broods, is such that the possibility of utilizing these trees as trap foods requires investigation. Preliminary studies in this line have been made, but extensive field experiments can not be undertaken before the spring of 1910.

The agent in field charge has been of practical service to many citrus growers from all sections of the State who have visited the laboratory at Orlando for advice and to many others who have asked for advice through correspondence. In this way much has been accomplished in furthering cooperative control measures against the white fly, particularly in sections newly infested.

INVESTIGATION OF HYDROCYANIC-ACID GAS FUMIGATION IN CALIFORNIA.

The work on hydrocyanic-acid gas fumigation in California, taken up at the beginning of the fiscal year ending June 30, 1908, was reported upon in a preliminary way in the last annual report, and the reasons for the investigation were there given. The work has continued along strictly economic lines, with the primary object of increasing the efficiency of fumigation, as well as decreasing its cost. The progress has been satisfactory. A large amount of new and useful information has been secured which, put into practice with the improved methods, has already practically revolutionized the old wasteful procedure which possessed none of the elements of uniformity. Much of this information has been incorporated in Bulletin 79 of the Bureau.

An important system of fumigation, which is both practical and scientific, has been introduced, and is rapidly leading toward a standardization of the entire practice. Within three months after its announcement to the public more than a dozen practical outfits had adopted the methods, while at present it would seem to be a fair estimate that before the next season closes practically all of the fumigating outfits in southern California will be working under the standard system devised by the Bureau. Results from the use of this system on several hundreds of acres of citrus groves have demonstrated a striking superiority over those gained previously, while it seems quite probable that after the general adoption of the system a single treatment every second year will accomplish the same results as an annual treatment, giving an annual saving of from 30 to 50 per cent of the present cost.

By the experimental treatment of several thousand trees under varying conditions the most economical dosage to be used against the purple scale and the red scale, the most injurious of the enemies of citrus trees in California, has been determined. These experiments have also covered the effects on the results secured of different periods of exposure of the insects to the gas. Exposure of one hour appears to be most effective against the purple scale, while for the red scale the time may be reduced to forty-five minutes.

A number of small practical points have been brought out, including the devising of a new cover for vessels which prevents the burning of tents and allows for the better distribution of the gas. The material used for making the tents has also been looked into, and a number of cloths very superior to those in present use have been found.

In important practical results the investigation has been one of the most satisfactory carried on by the Bureau of late.

THE ORANGE THRIPS.

A new insect enemy of the orange has become prominent in the San Joaquin groves of California, the groves of Portersville and Lindsay, and adjacent territory in Tulare County. This is an important and rapidly developing orange district, and extends along the western border of the Sierra foothills from a point east of Fresno to a point south of Portersville. The orange thrips has been present for some years, but recently its injuries have become so extensive as to attract general attention. It punctures the rind of the newly set fruit and of the older fruit, bringing about the scabby or russet condition and reducing the market value of the fruit. The tender foliage is also seriously injured, especially the foliage of nursery stock.

The investigation of this insect, although it affects citrus fruits, was assigned to the section of deciduous fruit insects, on account of its relationship to the pear thrips under investigation in the same State. A special agent was assigned to the problem in April, 1909, and is giving special attention to methods of control as based upon experience with the pear thrips, and at the same time is carrying on a detailed study of the life history and habits of the insect.

A combination of tobacco extract and distillate oil spray, which proved so effective with the pear thrips, will also kill the orange thrips, but it seems evident that a considerable number of applications will be necessary to protect the orange crop, on account of the continued breeding of the pest, which obviously has several generations and no long resting period, in contrast to the pear thrips.

INVESTIGATIONS OF INSECTS IN THEIR DIRECT RELATION TO THE HEALTH OF MAN AND DOMESTIC ANIMALS.

In the course of the investigations of insects in their direct relation to the health of man and domestic animals, mosquitoes have been actively studied as during the past decade, and new points of practical value have been brought out. It has been discovered that a large part of the mosquito supply of otherwise well-conditioned sections of large cities is sewer bred, and that the malaria-bearing mosquitoes in dry summers will breed in sewer traps, making it extremely important for the health officials to treat all sewer traps with kerosene or some other culicide.

WORK ON THE HOUSE FLY.

The work on the house fly has been continued, and a bulletin upon this insect and other disease-bearing insects has been published which has attracted still further attention to this unnecessarily dangerous pest. The crusade against the house fly indicated in the last annual report has become, during the past fiscal year, of almost a national character. So many boards of health have taken it up and so many civic organizations have concentrated upon this subject that the whole country may fairly be said to have been aroused. The writer has suggested in a recent publication that an effort be made to change the popular name of the house fly to the typhoid fly, with the idea that should people at large begin to think of it as a disease bearer they would no longer suffer its presence in the house and on their food with the same equanimity as in the past.

WORK ON THE TEXAS CATTLE TICK.

Substantial progress was made in the experimental work on the tick (*Margaropus annulatus* Say) which transmits splenetic fever of cattle. This work was conducted by Mr. W. D. Hunter and Mr. F. C. Bishopp. The observations on the habits and life history were in general in continuation of the work that was under way during the preceding fiscal year. Special attention was devoted to the determination of the points in life history that are of importance in the various systems of control involving the transference of the cattle from one pasture to another. This work is of great importance to ranchmen in the area that can not naturally be reached for some time in the plan of total eradication that is being sucessfully conducted by the Bureau of Animal Industry. Recent agitation has called the attention of cattle owners everywhere to the importance of reducing the number of ticks where the plan of total eradication can not be applied at this time. This has caused a demand for information that the Bureau's work supplies.

Considerable attention was paid to obtaining data regarding the developmental periods of the fever tick in different localities. Work done in one place will not necessarily apply elsewhere. For this reason cooperative experiments were conducted with the Tennessee and Arkansas stations and two experimental localities were utilized in Texas.

In addition to the foregoing work, which is the basis of any control measures that can be put into operation, the Bureau of Entomology conducted several practical demonstrations of the methods of reducing injury. The demonstration in Victoria County, in which an area of a square mile was used for the purpose of cleaning cattle of ticks, was repeated. Another experiment was carried on on a pasture in Calhoun County. In addition to this work, which has been done under formal agreements with the Bureau of Entomology, a number of ranchmen have taken up the work. Mr. J. D. Mitchell, of the Bureau, has assisted ranchmen in instituting work of this kind in connection with his experimental work.

Tests were made of the possibility of the carriage of fever ticks by animals other than cattle, horses, and sheep. It is highly important to know to what extent other animals may carry the fever species because the occurrence of a comparatively small number of ticks on some other host would nullify all of the work in eradication. It is therefore necessary to obtain very full information. Exceptional cases of various animals serving as hosts must be investigated with care.

In connection with the main work of the Bureau on the various species, attention has been directed to other forms that occur in the South. Several of these, like the lone star tick (*Amblyòmma americanum* L.), and the Gulf coast tick (*Amblyomma maculatum* Koch) are of considerable importance as parasites. Man, as well as many domestic animals, is affected by them. Moreover, some of them may eventually be found to be concerned in the transmission of diseases. For these reasons, as time permitted, studies of life histories and habits were conducted.

Some attention was devoted to the study of the fowl tick (*Argas miniatus* Koch) in Texas. In several parts of the world this tick has been found to be the agent in the dissemination of a very serious disease of fowls. In Texas this disease has not been found to occur, but the tick causes very serious injury merely as a parasite. In certain districts the profitable raising of poultry has been rendered impossible. An investigation of this tick has indicated feasible means of control that should enable farmers to reestablish the poultry industry where, in some cases, it has been abandoned.

There is another species, the spinose ear tick (*Ornithodoros megnini* Dugès), which is of importance in the western portion of Texas. This species lodges itself in the ears of cattle and horses and not infrequently causes death, especially in the cases of young animals. While no special experiments could be conducted, observations regarding the extent of damage and the possible means of control were made in connection with the other work. This tick is of sufficient importance to justify special investigation.

A parasite of a tick (*Rhipicephalus texanus* Banks) closely related to the fever-transmitting species was found in southwestern Texas. Experiments were instituted to cause this parasite to attack the cattle tick, but up to this time without success. The parasite is very common in the region of Corpus Christi, Tex., and has an important effect in checking its host, which occurs on the dog. The attempt to cause the species to attack the cattle tick is of especial interest.

A limited amount of work was done on the tick which transmits the so-called spotted fever of human beings.

WORK ON INSECTS INJURIOUS TO STORED PRODUCTS.

Work on insects injurious to stored products, under the direction of Dr. F. H. Chittenden, has been carried on in the directions indicated in the last report.

In continuation of the investigations begun in 1908 at the request of many milling companies in Kansas, Oklahoma, Missouri, and

Texas, and of steamship owners and operators in Texas and Louisiana, much work has been done. Especial attention has been given to the flour beetles and to the determination of the place or places at which export flour from the different States mentioned becomes infested, whether chiefly at the mills or at Galveston, or at New Orleans, or on the cars, steamships, or wagons used in carting the material from the mills to the carrier. There is no doubt that infestation occurs at all of these points, but it is feared that in some cases primary infestation begins at the milling establishments, although some of the mills which have been investigated are kept scrupulously neat and are thoroughly fumigated at least twice yearly.

The insect which has recently engaged the most attention is the Mediterranean flour moth, which seems to be the most destructive mill pest in the world. It was first recognized in this country in 1892, and has since been reported from almost every important milling section of the United States. Investigations by the Bureau seem to indicate that fumigation of milling establishments with hydrocyanic-acid gas is the most perfect method. Bisulphid of carbon is less effective as a rule, and the same may be said of fumigation with sulphur dioxid. It seems possible to stamp this species out with the cooperation of all the milling establishments concerned in any given locality. Experiments indicate that the insects can be destroyed in a badly infested building with two fumigations at the rate of 8 ounces of cyanide of potassium to 1,000 cubic feet of space, provided the buildings have been tightly closed. The economic importance of this pest is indicated by the fact that one miller has stated it has cost him $5,000; another one that it costs $2,000 per year for fumigation.

Several stored-product insects have attracted much attention during the year. These are the granary and rice weevils, the Angoumois grain moth, and the flour beetles. Some new habits of these insects have been discovered, and the experiences of practical grain dealers and millers are being collected, with a view to the publication of a full report on insects affecting stored cereals.

INSPECTION WORK.

As in previous years, the plant material introduced by the Bureau of Plant Industry has been inspected at the Department greenhouses for dangerous insect pests and has been fumigated wherever necessary. Special attention during the past year has been paid to the fumigation of all mango stock on account of the presence of two new Indian scale insects. During the course of the year 1,710 certificates of inspection were granted. Since the regulation of the express companies requires a certificate of inspection to accompany any plant material for shipment, and since there is no official nursery inspector for the District of Columbia, this general inspection work has fallen upon this Bureau. One hundred and four certificates were granted for trees and plants shipped from the District of Columbia, and 2,495 lots of plants imported by the Division of Seed and Plant Introduction of the Bureau of Plant Industry have been inspected for insect pests. Besides numerous cosmopolitan pests, several apparently new species of insects were found and killed.

INSPECTION OF TEA FARM.

During March, 1909, Doctor Shepard, the owner of the tea farm at Summerville, S. C., sent specimens of tea leaves infested with scale insects which were threatening to destroy the plantation. An expert was sent to the farm and found five dangerous scale insects of Asiatic origin infesting the tea plants and neighboring camellias. Since all the tea plants were grown from seed, the method of introduction of these scales was unknown until it was found that large numbers of Japanese camellias had been introduced and planted near the tea plants.

INSPECTION FOR BROWN-TAIL MOTH.

In January, 1909, the Bureau was advised by the commissioner of agriculture of the State of New York that the brown-tail moth had been found in shipments of seedlings from Angers, France. Later advices from Ohio indicated that the winter nests of the brown-tail moth had been found upon seedlings imported from the same locality. Warning letters were sent to different state entomologists; the customs officers at the different ports of entry were notified by the Secretary of the Treasury to inform the U. S. Department of Agriculture immediately upon the arrival of any nursery stock from abroad; the principal railroads were notified of the danger of carrying such plants, and their attention was called to the law of March 3, 1905, providing that no transportation company shall knowingly carry plants infested by injurious insects, under a penalty of a fine of not more than $5,000, or imprisonment at hard labor for more than five years, or both. As a result, not only customs officers but the railroads promptly notified the Bureau at Washington of the ultimate addresses of all cases of plants received, and in this way the Bureau was enabled to notify state inspectors and other competent persons near the points of ultimate destination of such packages, and inspection was thus brought about in all probability in all instances where plants were received after January, and probably also before that date, since information was received from the customs officers of the destinations of the early winter and late autumn receipts. The Bureau was in this way enabled to send notifications of nearly 800 shipments, divided among 35 different States. In fifteen of these States, namely, Alabama, Georgia, Illinois, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Missouri, Nebraska, New Jersey, New York, North Carolina, Ohio, and Pennsylvania, nests of the brown-tail moth were found, and in one locality in Ohio a single broken egg-mass of the gipsy moth was found. Prof. P. J. Parrott, of the New York State Agricultural Experiment Station at Geneva, N. Y., has found in his summer's inspection that still another European fruit-tree pest (*Hyponomeuta padella*) has been introduced, probably on these French seedlings.

NECESSITY FOR A NATIONAL QUARANTINE AND INSPECTION LAW.

This concerted effort to destroy all these imported insect pests was probably successful, but the danger of such shipments was emphasized in a more striking manner than ever before. The United States is practically the only one of the great nations of the world which has not protected itself from such accidental importations of pests of this character by a national quarantine and inspection law. Such laws have been introduced before Congress in previous years, but have failed of passage. Toward the close of the last session of Congress a national quarantine and inspection bill was drafted and sent to Congress by the Secretary of Agriculture. It passed the House of Representatives, but failed to pass the Senate. The bill as introduced was not satisfactory to the legislative committee of the American Nurserymen's Association, but it is hoped that a measure more satisfactory to them may be introduced at a later date and that the whole country will receive protection through its operations.

In June, 1909, the Chief of the Bureau visited Holland, France, and England for the purpose of looking into the European methods of growing nursery stock for the American market and of investigating the nursery-inspection systems in those countries, which are the greatest exporters to America. He found that the inspection system of the Government of Holland under the direction of Prof. J. Ritsema Bos, director of the pathological station of Wageningen, is admirable. All of the Dutch nurseries are carefully inspected twice each year. The nurserymen are well educated on the subject of remedies. The Ritsema Bos inspection certificate can be relied upon.

In France it was found that there is no governmental inspection system of nurseries. The certificates attached to shipments of nursery stock received in this country coming from France are signed, as a rule, by men connected with the agricultural schools, and, as last winter's experience has shown, are not reliable. Nursery stock for export is, in many cases, grown in the vicinity of hedges and trees infested by brown-tail moths, by the gipsy moth, and by other injurious insects as yet not introduced into the United States, and down to the present time there seem to have been no special precautions taken by the nurserymen to prevent the infestation of their stock by injurious insects. It seems reasonably sure that the infested nursery stock imported last winter into the United States came from such regions as have just been described. In the late June and July flight of the adult brown-tail moths coming from hedges or woods adjoining nursery plantations many of these moths must have laid eggs upon the young nursery stock in the vicinity. These eggs hatched in August, the very small young larvæ fed somewhat upon the leaves, webbed up into their characteristic winter nests, and were sent with the seedlings to America. The nests are noticeable, and only extreme carelessness, indifference, or ignorance on the part of the French exporters could have allowed them to be packed without removal. The French exporters now promise to take all possible precautions, and the French minister of agriculture has promised to found a competent governmental nursery inspection service under the direction of Dr. Paul Marchal, a most learned and competent man, and to thus guarantee the freedom from pests of nursery stock shipped to the United States in the future.

In England, as in France, there is no governmental nursery inspection. Conditions in the nurseries are somewhat better than they are in France, but the brown-tail moth occurs in England, and other very injurious insects which may easily be imported upon nursery stock.

Officials of the government board of agriculture, in London, stated that the Government had had the establishment of an inspection service under consideration, and was perfectly willing to institute such a service, but that the demand must come from the British nurserymen themselves. Therefore, prominent members of the National Horticultural Trades Association of Great Britain and Ireland were interviewed, and the near establishment of a competent inspection service under the board of agriculture seems probable.

INTERSTATE INSPECTION.

During the fiscal year 1909 the file of the state nursery and orchard inspection laws has been made complete by continued correspondence with the state inspectors in charge, and a revised circular has been issued, giving the requirements for shipping nursery stock into the different States, for the benefit of people engaged in this industry. It is necessary to devote considerable attention to this matter, as new laws are being enacted almost every year and new regulations are continually being made by the inspectors or official boards in charge of the work. An effort has been made to secure data concerning the cost of inspecting nurseries in the United States, the amount appropriated to carry on this work, and the work of orchard inspection as well. A statement of the number of orchards annually inspected has been compiled, with the views of the different inspectors concerning the efficiency of the work under state supervision as it is now being conducted. This information should be of considerable value as forming a good basis for a general law bearing on the inspection of importations from foreign countries.

WORK IN BEE CULTURE.

The work in bee culture has been carried on, as before, under the direction of Dr. E. F. Phillips, and covers practically the same projects as in the previous year.

WORK ON BEE DISEASES.

The main line of work carried on this year was, as in former years, an investigation of the brood diseases of the honey bee. The study of the micro-organisms that cause disease or are found in diseased material has been continued. As was stated in the last annual report, the cause of American foul brood was determined in the investigations of this office, and during the year a further study of this organism has been made. The cause of European foul brood is not yet fully established, but a study of one organism (temporarily named "Bacillus Y") now under investigation promises favorable results as soon as more suitable culture media can be obtained for its cultivation. Extensive experiments on the amount of heat and chemical disinfectants necessary to kill the spores of *Bacillus larvæ*, the cause of American foul brood, have been begun during the year. These results are highly important in determining the methods of disinfection to be used in treating an infected apiary.

Work on the distribution of the different brood diseases was taken up on a more extensive scale at the beginning of the season of 1909, and samples are now being received from all parts of the country. The material for this work was obtained by sending out circulars to correspondents of the office and by advertisements in bee journals. During the past year 280 samples were received and examined, of which 180 were obtained during June. This taxes the capacity of the present bacteriological laboratory. The information gained from this work has already been of great value, especially in giving information to state legislatures which are contemplating the passage of laws providing for the much-needed inspection of apiaries. At the close of the present season all of the available data will be arranged geographically for publication. This is the first extensive attempt at a study of the distribution of bee diseases in this country. Circulars giving symptoms and treatment of the various bee diseases are sent out to all bee keepers whose names can be obtained in regions from which samples are received, and every effort is made to aid the bee keepers in getting the diseases under control. The practical value of this work is perhaps greater than that of any other line of work now being attempted, nor is there any aid more needed. It was found that European foul brood has recently appeared in the San Joaquin Valley in California and in western Mississippi, causing considerable damage. In these cases special circulars were sent out to bee keepers in the regions especially in danger. The work on distribution is showing the presence of disease in many localities previously unreported, and indicates even greater losses from this source than have been recognized in the past.

During the past winter a large paper was almost completed reviewing all the work that has been done on the cause of infectious diseases. This will help greatly in clearing up the confusion still existing in the minds of many bee keepers as to the nature and extent of the work which has been done by the various investigators who have worked on this subject.

The work on new and better methods of treatment which was begun on a large scale during the fiscal year 1907–8 was continued the past fiscal year, as far as the apiary facilities would allow, with very valuable results. This work is being continued during the present season, the object being to get less expensive methods. This work will require considerable time and labor.

During the past year the bee keepers of several States have been active in attempting to get laws enacted providing for inspection of apiaries. Satisfactory laws of this kind were passed in South Dakota, Indiana, and Iowa, and proper regulations were made in Hawaii. The proposed bills failed of passage in Pennsylvania, New Jersey, Massachusetts, Connecticut, and Illinois. The proposed revisions of previously enacted laws in California and Texas also failed. The chief reasons for failure in these cases is that but few bee keepers go before the legislatures and those who do go are not provided with sufficient data as to the distribution of the diseases and losses resulting from them. This office helped in the drafting of several of the proposed bills, and aims to aid in every legitimate manner by furnishing information as to the distribution of diseases and the losses resulting therefrom.

STUDIES OF THE STRUCTURE AND DEVELOPMENT OF THE BEE.

Work on almost all other lines of apicultural investigation has shown the very urgent need of a careful and detailed study of the structure and development of the bee. The knowledge of the average bee keeper concerning the animals with which he works is much less than that of men engaged in almost any other line of animal industry. Without knowledge of this character it is very difficult, if not impossible, to make proper progress in a study of the pathology of bee diseases, queen rearing, behavior and activity of the bee, and many other important lines of investigation. The work done by other investigators has been shown, in the main, to be either very inaccurate or incomplete and, to supply these wants, investigations in these two fields were carried on during the past year. Such work will not only add greatly to our knowledge of the bee, but will unquestionably be of great value in devising and correcting practical manipulations. It can scarcely be expected that the average bee keeper will show much interest in such work, but the practical results of such investigations will prove of great value to investigators and of interest to all progressive bee keepers.

WAX ANALYSIS.

During the past year a beginning was made in collecting samples of beeswax from all parts of the United States for analysis and study. These samples are to be turned over to the Bureau of Chemistry for analysis, and tests will also be made of the bleaching properties and in other ways to determine the relative commercial value of the various waxes. It is hoped to prepare for beeswax a mass of material comparable to what has been done for American honeys, as reported last year. Some work was done on methods of wax extraction.

THE ACTIVITY OF BEES.

The work on the daily activity of a colony, mentioned last year, has been brought to a close, and results will be prepared for publication soon. Some investigations were made as to the methods of gathering propolis and the sources from which it is gathered. This has been a much debated question among bee keepers since Huber's time.

The basis for intelligent practical manipulation rests almost entirely on a knowledge of bee behavior. The literature on this subject is very scattered and there is no single available English publication which can be relied on fully. A general review of this subject with some new observations has been begun during the past year and will be completed as soon as possible.

STUDY OF THE STATUS OF BEE KEEPING.

During the past year a publication (Bul. 75, Part VI) was issued giving a summary of the best available information concerning the present conditions of the bee-keeping industry in the United States. Another publication (Bul. 75, Part V) of the year was a report on bee keeping in Hawaii, this being an account of the trip to Hawaii mentioned in the last annual report. As supplementary to this, a paper was issued by the Hawaii Agricultural Experiment Station on Hawaiian honeys. The detailed study of bee keeping in Massachusetts, mentioned last year, is completed and the results have been published. (Bul. 75, Part VII.)

Detailed studies of bee-keeping conditions have proved so valuable that similar work is being carried on in Maryland, Pennsylvania, and parts of Virginia. By getting in direct touch with bee keepers it is possible to locate many new outbreaks of disease and to help in various other ways. It is also a great help in getting our publications into the hands of bee keepers. It is hoped to enlarge the scope of this work as rapidly as possible.

UNCLASSIFIED WORK.

Much work has been carried on during the fiscal year which can not be classified under the main topics already considered.

INSECTS INJURIOUS TO THE PECAN.

Investigations of insects injurious to the pecan, made in earlier years and carried on with a fair degree of success by means of special correspondents, and later by the help of a special agent, have been continued. An agent has been stationed in Florida, taking occasional trips into South Carolina. The principal insect under investigation has been the pecan bud moth, which seems to be the most injurious enemy of the pecan tree. Its life history has been under especial study. Similar life-history studies have been made upon another bud moth, upon a leaf miner, and upon certain forms of borers. A preliminary report will soon be put into shape.

INSECTS INJURIOUS TO SHADE TREES AND ORNAMENTAL PLANTS.

There is great demand for information in regard to insects injurious to shade and ornamental trees, and an effort is constantly being made to bring the published information to date. The facilities for extensive experiments, however, are slight. Circulars and Farmers' Bulletins containing information in regard to some of the principal pests, such as the tussock moth, fall webworm, imported elm leaf-beetle, bagworm, green striped maple-worm, red spider, the rose slugs, and the leopard moth, as well as the cottony maple scale, have been published.

A large amount of time is taken up in correspondence on this class of pests each year.

WORK ON SCALE INSECTS.

During the year a large amount of scale-insect material has been received from different parts of the world and carefully studied by experts. It is most important that the Bureau should be thoroughly informed on the scale insects, not only of this country but of all parts of the world, since there is no group of insects so liable of introduction from one country to another as this group. A second supplementary list of recently described scale insects, with full bibliography, has been prepared for publication.

OTHER WORK.

An elaborate attempt has been carried on to systematize all the notes and records of the Bureau and to verify the determinations of practically all specimens referred to in the notes. A large number of biological records have been made of species hitherto unstudied in the Bureau.

Work on the part of specialists in the Bureau, referred to in previous reports, in the determination of specimens sent in by state entomologists and other workers in practical entomology, has increased. A close estimate of the number of specimens named in this way during the fiscal year reaches the very large total of 23,000. The correspondence of the Bureau continues to increase. During the fiscal year, in addition to answers to correspondence by circulars, nearly 19,000 letters have been written.

The publications of the Bureau during the year have reached 23 numbers.

PROPOSED WORK FOR THE FISCAL YEAR 1910.

At the present writing the work for the fiscal year 1910 is well under way and, in part, consists of a continuation of the lines just indicated.

With the gipsy moth and brown-tail moth very slight changes in methods and plans are being considered. Constant effort will be made to reduce the cost of the methods in use, and constant experimentation will be carried on, in the hope of finding some large wholesale manner of caring for woodland regions. Where property is of sufficient value or interest to the owners, the moth is handled without great difficulty, but the large tracts of low-priced woodlands, where the owners can not afford or are unwilling to spend any considerable sums of money, constitute the most serious problem in the course of the work.

It is planned to continue in the same way the importation of useful insects, especially the parasites of the gipsy moth and brown-tail moth, of the imported elm leaf-beetle, and of the codling moth.

With the Mexican cotton boll weevil the most important work is being conducted in Louisiana. Two years' experience in that State have convinced all careful observers that special means of control of the weevil must be devised to suit the peculiar conditions which exist in the Mississippi Valley. The methods that have been successful elsewhere have been tried, and have been found inadequate. The means utilized in Texas resulted from careful technical studies of the life history and habits of the weevil. Logically, therefore, since in the Mississippi Valley the conditions are so different, similar careful technical studies of the life history and habits of the weevil must be made there as the basis for remedial work. For these reasons the Bureau has established a laboratory at Tallulah, La., in a region typical of the Mississippi Delta country. All features of the life history of the weevil are being carefully investigated there, and field experiments with new lines of control have been instituted. This work will occupy the attention of three expert assistants resident in the delta. Especial attention will be paid to the increased effectiveness of parasites. This is the most hopeful aspect of the situation at present, but every possibility will be investigated with care. As heretofore, the experimental field work, however, will be continued throughout the whole infested area. As far as practicable, the work will be reduced in Texas and increased in Louisiana. In the latter State field work is under way at eight places. Experiments with machinery for the control of the beetle will be continued. The status of the weevil will be determined from time to time, and estimates of damage will be made and field work in the determination of the extent of dispersion will be carried on for the benefit of States that have quarantines in operation, as well as for the information of planters, who must make the earliest possible preparation for the arrival of the pest. Moreover, attention will be paid to the discovery of isolated colonies, and if any should be discovered, energetic attempts will be made to stamp them out.

With regard to tobacco insects life-history studies will be continued, and demonstrations, through cooperative experiments as to the effect of poisons, with fall plowing and other methods, will be carried on.

New projects under the section of southern field crop insect investigations have been entered on during the fiscal year 1910. For many years the insect enemies of sugar cane and rice have levied their regular tax upon two of the more important agricultural industries. In 1902 the entomologist of the Louisiana Experiment Station estimated a loss of $54,000 for the season on one plantation of 3,227 acres of cane. In 1908 it was ascertained from thoroughly reliable sources that the damage by a single insect on one sugar plantation near Brownsville, Tex., amounted to $10,000.

Among the rice insects it is estimated that the root weevil was responsible for an annual loss in Texas alone of $360,000. The fact that the boll weevil is forcing many planters to abandon cotton and put their land in sugar cane and rice gives additional importance to these enemies of these crops. The Bureau has obtained the services of Mr. D. L. Van Dine, formerly of the Hawaiian experiment station, to engage in a special investigation of sugar-cane and rice insects under Mr. W. D. Hunter. On account of the necessity of beginning the work near the middle of the crop season, in 1909, it will be possible to do little more than make a general survey during the remainder of the season. This will be carefully done; the special problems that need attention will be determined, and the best places for experimental work will be selected. This preliminary work will enable the agent in charge to undertake strictly control measures with the crop of 1910.

In connection with the work on sugar-cane insects, an investigation of the Argentine ant has been begun, and will be carried on throughout the year. The ant is a serious pest in houses, in orchards and gardens, and on cane fields—in the latter instance since it protects and cultivates the mealy bug of the sugar cane. During the fiscal year 1910 work on the ant will be restricted to the sugar-cane aspect of its habit. The cooperation of the entomologist of the Louisiana Agricultural Experiment Station has been obtained, and an agent has been stationed in Louisiana to devote his full time to the determination of the exact importance of the ant in its relation to the cultivation of sugar cane and, if possible, to devise practical means of control.

In connection with the investigation of insects affecting southern crops an incidental study will be made of the cotton red spider in South Carolina and adjoining States, and the cotton root-louse, which occurs in the same region. It is the opinion of the state entomologist of North Carolina that the root-louse is perhaps the most important insect enemy of cotton in that State.

The work upon cactus insects will be completed during the year, and work upon the life histories of ticks will be continued.

With forest insects the investigations of the past fiscal year will be continued. With insects affecting deciduous fruits the work in general will be a continuation of the lines already in progress. The pear thrips problem being practically solved, it remains only to carry on large-scale demonstration work, in order to show fruit growers exact methods and results. The work upon cranberry insects, the orange thrips, and codling moth will be continued. The work upon the grape root-worm will be practically discontinued, but work upon the apple maggot will be begun.

With the cereal and forage-crop work there will be no great expansion of the investigations, but work will be begun with a Hemileuca caterpillar damaging stock ranges in New Mexico and upon the alfalfa weevil injuring the alfalfa crop in Utah, as also with the leafhoppers affecting pastures.

PLANS OF WORK RECOMMENDED FOR YEAR ENDING JUNE 30, 1911.

In accordance with the request of the Secretary of Agriculture, no increases in the estimates for the year 1911 over the appropriations for 1910 are made. Some small changes of funds from one investigation to another are recommended. The practical completion of the pear-thrips investigation in California renders it desirable to reduce the sum set aside for the investigation of deciduous fruit insects by $6,000, and to add that amount in part to the investigations of insects affecting forage crops, for the especial investigation of the Hemileuca caterpillar in New Mexico and the alfalfa weevil in Utah, and in part also to the fund for the investigation of forest insects, which needs additional assistance. There are very strong reasons for urging certain increases in promotions, but as the reasons for reducing the expenses of the Government seem even stronger, no recommendations in this direction are made.

REPORT OF THE CHIEF OF THE BUREAU OF BIOLOGICAL SURVEY.

U. S. Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., October 23, 1909.

Sir: I have the honor to transmit herewith a report on the work of the Biological Survey for the fiscal year ended June 30, 1909, with outline of work for 1910.

Respectfully,
C. Hart Merriam,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

WORK OF THE BIOLOGICAL SURVEY.

The work of the Biological Survey as laid down by Congress is conducted under three general heads: (1) Investigations of the economic relations of birds and mammals to agriculture; (2) investigations concerning the geographic distribution of animals and plants with reference to the determination of the life and crop belts of the country; (3) supervision of matters relating to game preservation and protection, and importation of foreign birds and other animals.

ECONOMIC MAMMALOGY AND ORNITHOLOGY.

HOUSE RATS.

During the past year the causes of the continued abundance of house rats have been investigated with a view to the suggestion of adequate means of relief. Hitherto efforts against the pests both in the United States and in foreign countries have been directed chiefly to their destruction, with the result that while in all parts of the civilized world enormous numbers have been killed, rats still continue to flourish, chiefly because their wonderful reproductive powers enable them in any given locality to make good their losses very soon after the warfare against them has relaxed.

Traps and poisons of many different kinds have been experimented with during the year, and the results published in a recent bulletin. These methods of reducing the numbers of rats are believed to be necessary, and are very successful when intelligently and persistently employed, especially when food supplies are cut off. Careful experiments also have been made with certain bacterial preparations which are being widely advertised and sold as efficient rat exterminators.

The results obtained do not justify recommending them to the public. The cultures are neither cheap nor certain of action and, more important still, experiments have failed to show that they induce contagious diseases. Usually their effect is limited to the individuals eating the infected bait, and hence they are no better—and much more expensive—than certain well-known mineral and vegetable poisons.

While means of destruction have a decided value and must continue to be employed, they should be viewed only as auxiliaries to surer, and in the end much more economical, measures. Three recommendations are considered of primary importance: (1) The rat-proofing of all buildings that can possibly harbor the vermin; (2) the fumigation of rat-infested ships, especially freighters; (3) the withholding of food supplies from rats.

(1) RAT-PROOFING OF BUILDINGS.—The cost of rat-proofing dwellings, stables, markets, and public buildings is slight compared to the losses the rats that harbor in them inflict on food, clothing, merchandise, and wooden structures, to say nothing of the menace the animals are to public health.

(2) FUMIGATION OF SHIPS.—In connection with efforts to rid cities, especially seaports, of rats, too little attention has been paid to the agency of vessels, especially freight carriers, in distributing the vermin. Great numbers of the rodents are transported in vessels from country to country and from seaport to seaport, and the loss they cause by the destruction of goods in transit is very great. But far more important is the fact that it is chiefly, if not wholly, by the agency of rats transported in vessels that bubonic plague is carried from one country to another. By modern methods of fumigation vessels can be cleared of rats, and, incidentally, of all other vermin, at slight expense. Seaports can never be permanently freed of rats, no matter how large the sums expended, when incoming vessels carry hundreds of rodents ready the moment opportunity offers to exchange their limited quarters aboard ship for the friendly land. If the general rat-proofing of dwellings and other buildings can be effected, and if at stated intervals the disinfection of vessels that transport and distribute rats can be made mandatory, important steps will have been taken toward a final solution of the rat problem.

(3) WITHHOLDING FOOD SUPPLIES.—A third vitally important measure, possibly the most important of all, is the withholding of food supplies from the rodents. In towns and cities this can be effected by strictly enforced ordinances compelling the storage of kitchen and market refuse and all sorts of waste food in closed metal containers, which must be emptied systematically and often. Not the least important gain by withholding ordinary food supplies from the rats is the increased efficiency of traps, poisons, and other devices for destroying the pests, which, when food is abundant, are comparatively useless.

The above measures would result in so reducing the numbers of rats that they could do little harm, and no doubt within limited areas they might be exterminated. It is of the utmost importance to recognize the fact that the destruction of rats by any and all known means can, from the nature of the case, afford only temporary relief, and that complete freedom from the pests will follow only when repression is supplemented by prevention.

GROUND SQUIRRELS.

Most of the territory west of the Mississippi River is infested by ground squirrels. Though the many species vary much in size and in capacity for mischief, all are destructive, and in certain regions, especially the wheat regions of Washington, Oregon, Idaho, and California, they do an immense amount of damage every year. So destructive are they in certain localities that between the amount of grain they destroy and the cost of fighting them a large part of the profit of wheat raising is swallowed up. For a long time experiments have been conducted for the purpose of finding cheap and effective methods of destroying the animals. One of the larger and most destructive species is the so-called Columbian ground squirrel of eastern Washington. Thus far attempts to poison this species on a sufficiently large scale to stop its ravages in the wheat fields have failed, and the best way of holding it in check is by the use of steel traps.

The Beechey ground squirrel of California is another destructive species. This animal has been for years a perennial source of annoyance and loss in California, and immense sums have been expended in attempts to control its ravages. The importance of its destruction on a large scale, since its extermination does not seem possible at present, has been emphasized by the recent discovery by the Marine-Hospital Service that, like the rat, this animal, through the agency of the flea it harbors, has become a factor in disseminating bubonic plague. In the outskirts of towns situated near the seacoast the squirrels obtain plague-infected fleas from rats and, in turn, become hosts for this dread disease.

For some time the Biological Survey has been conducting field experiments with a view to the discovery of better and less costly methods of destroying the animals, and during the past few months its efforts have been most successful.

Cooperation with the Marine-Hospital Service.—At the request of the Chief of the Public Health and Marine-Hospital Service, the Chief of the Bureau furnished for publication a paper defining the distribution of three species of California ground squirrels, describing their general habits and giving approved methods of destroying them by means of traps, poisons, and gases.

FIELD MICE.

No outbreaks of field mice comparable to the one which did so much damage to the alfalfa fields of Humboldt and Carson valleys, Nevada, in 1908, have been reported during the present year. These areas were revisited in August for the purpose of ascertaining to what extent the mice had been destroyed. It was found that the wholesale poisoning carried on by the Survey, together with disease, had so reduced the number of mice that their natural enemies, especially hawks, owls, gulls, and coyotes, had almost exterminated the rest, there remaining in the spring probably not more than 5 or 6 to the acre, whereas during the height of the scourge small areas contained no fewer than 12,000 to the acre. At both Lovelocks and Minden few signs of mice were seen. In consequence of their scarcity most of the hawks and owls, and probably also the larger carnivores, had betaken themselves to new hunting grounds, but when the fields were irrigated in the spring gulls reappeared in large numbers and, following the water from field to field, destroyed the remaining mice and pocket gophers flooded out of their holes. If the natural foes of rodents were everywhere protected and allowed to populate the country in normal numbers, they would exercise a constant check on the rodent pests, which then would rarely, if ever, multiply so as to become a scourge.

In many localities field mice infest orchards, and, as they work underground, they often, especially in winter, do great damage before they are suspected. A case in point occurred at Massies Mill, Va., where depredations by field mice in an orchard were reported, and an assistant was sent to investigate. Of a total of over 2,500 trees, probably more than half were damaged by mice, which girdled the roots below the ground. The cure in such cases is usually easy, as field mice can be readily poisoned with strychnine.

WOLF AND COYOTE BOUNTIES.

The bounty system designed to bring about the extermination of certain noxious animals, especially wolves and coyotes, has in many places proved an incentive to fraud, and thousands of dollars have been paid for the scalps of dogs, foxes, coons, badgers, and even cats and calves, which have been palmed off for wolves or coyotes. To aid state and county officers in identifying the scalps of wolves and coyotes, especially the young, a key has been prepared describing the essential distinguishing characters. This has been distributed freely in the bounty-paying States, and is expected to effect a substantial saving.

FENCING SHEEP FROM WOLVES AND COYOTES.

For several years the Survey, as a result of its own and of private experiments, has recommended the use of wire fencing as the most effective means of protecting sheep against wolves and coyotes. This method has the additional advantage that the pasturage within the inclosure is more abundant and of better quality than when sheep are grazed in compact herds under the care of herders. In 1907 the Forest Service inclosed an experimental sheep pasture in the Imnaha National Forest, Oreg., with a wire fence, the specifications for which were furnished by the Survey. The plan has proved a complete success. As wolves and coyotes are practically the only predatory animals feared by sheep owners in most parts of the country, it is believed that these wire fences will solve the sheep problem in many places where now the annual losses from wolves and coyotes are almost prohibitive of the industry.

DITCH BORERS.

As is well known, muskrats, pocket gophers, ground squirrels, and other rodents do much damage by tunneling into dikes, fills, and water ditches, thereby causing extensive breaks, which are costly and difficult to repair.

At the request of the Reclamation Service the subject was investigated by the Survey and efficient means of trapping and poisoning the animals were devised and demonstrated to the engineers in charge of several of the projects. An examination of many miles of ditching during the past season showed few traces of mammal work, and the engineer in charge of the work at Fallon, Nev., reports that in consequence of the trapping and poisoning carried on by the ditch riders no important breaks had occurred during the year, whereas formerly breaks were numerous.

DEPREDATIONS BY KANGAROO RATS.

Hitherto few complaints have been received of depredations by the group of rodents known as kangaroo rats, the species of which are confined to the arid region west of the Mississippi. Early in the spring, however, reports were received of damage by these animals in vineyards of the Ben Lomond Wine Company, Santa Cruz Mounttains, California, and request was made for a remedy. The animals had bitten off the fruit buds to store in their underground galleries, and the manager estimated the aggregate loss to be fully 25 tons of grapes. It was recommended that raisins poisoned with strychnine be freely distributed near the burrows of the rats, with the result that when the place was inspected in September by an assistant of the Survey, very few were found to have survived. Few of our rodents are more easily poisoned than kangaroo rats, and it is believed that wherever they are troublesome, as they occasionally are in both vineyards and wheat fields, their numbers may be speedily reduced by the above means.

MOLES.

Despite the fact that moles are almost exclusively insectivorous, complaints against them are frequent because of damage in gardens, especially to plants and bulbs, supposed to be the work of these animals. In such cases the real offender is almost always the field mouse and not the mole. Nevertheless the mole occasionally injures lawns by tunneling under and upheaving the turf. Hence during the year experiments were made to determine the practicability of poisoning the animals, and considerable data on their food habits were gathered.

MAMMALS OF THE ARID INTERIOR.

The great reclamation projects now under way in the far West are making available for agricultural uses great tracts of desert land hitherto inhabited chiefly by wild animals. Many of the settlers are new to the region, and being wholly unacquainted with its animal life, are unable to distinguish friends from foes. At the request of the Reclamation Service and of some of the resident farmers, a bulletin has been published describing briefly the appearance and habits of the commoner mammals of the region, so that the farmer may be enabled to distinguish the beneficial from the injurious kinds. To add to the practical value of the bulletin the best methods of destroying the noxious species are also given. Though the bulletin applies more particularly to the Carson and Humboldt valleys, Nevada, it serves almost equally well for nearly the entire sagebrush region of the Great Basin.

MUSKRATS.

The diminished numbers of fur-bearing animals and the enhanced value of furs invite attention to measures for increasing the supply. To-day one of the most important of the American fur-bearers is the muskrat, which is still numerous and widely distributed in the United States, and whose fur is suited to a variety of uses.

Unlike some of the fur-bearers, as the fox, the muskrat can not be profitably raised in a semidomesticated state, but its food and other habits are such that large areas of marsh land along river and coast, of small value for agricultural purposes, may profitably be devoted to the animal. This is already done on the eastern shore of Maryland, and tracts of considerable size have yielded much larger returns in muskrat pelts than could have been obtained from them in any other way.

The muskrat is already protected wholly or partly in many States. Its importance as a fur-bearer, however, should secure its protection in all. A closed season of at least nine months should be established, which should include all the breeding months. The muskrat is prolific, has several litters a year, and, if properly protected, will not only hold its own but will increase in numbers.

The flesh of the muskrat furnishes an excellent and nutritious food, and in sections where its qualities are known it finds ready sale in markets at prices which add considerably to the returns from the pelts.

It is only in a few places, where farming land closely adjoins streams or marshes, that the animal injures crops, and in such cases the crops are usually easily protected. But the damage to ditches and embankments, particularly in certain irrigated areas of the West, is more serious. A bulletin covering these and other phases of the subject has been prepared.

DEER FARMING.

The Survey has continued to collect statistics relating to deer and elk parks, and also information concerning attempts to raise deer for venison. The Farmers' Bulletin issued last year, giving practical directions concerning deer farming, has been supplemented by a fuller report on the same general subject.

RELATION OF BIRDS TO THE BOLL WEEVIL.

In November an assistant of the Survey visited Adams, Jefferson, and Wilkinson counties, Miss., to study the relations of birds to the boll weevil. This State has recently been invaded by the pest in its march eastward, and the investigation was for the purpose of ascertaining to what extent birds were eating this, to them, new insect. It was found that only a few were doing so, a result which confirms previous experience in other places. Time is required for birds to learn the habits of newly introduced insects, so as to become efficient in their destruction. No doubt in Mississippi and the other Gulf States, as they in turn are invaded by the weevil, the resident birds will learn to attack the weevil in the cotton squares and other hiding places, and thus will lend material aid in checking its spread and diminishing its numbers, as they have already done in Texas.

CALIFORNIA BIRDS IN RELATION TO THE FRUIT INDUSTRY.

Orchard trees are peculiarly subject to the attacks of insect pests, and in a State like California, where the acreage devoted to fruit, already large, is constantly increasing, a knowledge of methods of controlling such pests is very important. Since birds consume enormous numbers of insects, they are valuable auxiliaries in reducing the ranks of insect pests. Both because of their insectivorous habits and because some birds eat fruit, a knowledge of their food habits is important to orchardists. Accordingly, investigations of California birds in relation to the fruit industry have been carried on for several years. During the past year Part II of a report on the subject has been finished. Although dealing specifically with California birds, much of the information it contains applies also to the fruit districts of the entire West Coast.

ENGLISH SPARROW.

As outlined in the last report, efforts have been made in connection with the local authorities of Los Angeles County to exterminate the colonies of English sparrows which have thus far gained a foothold south of Tehachapi Pass, and thus prevent the disastrous spread of the species in Southern California. In order to avoid duplication of work, arrangements were made whereby the county game warden in charge of the work for the county board of supervisors devoted his efforts to Los Angeles and the stations along the Southern Pacific Railroad northward to Lancaster. He reports that in this territory about 1,682 birds were destroyed, as follows: Los Angeles, 9; Newhall, 166; Saugus, 31; Ravenna, 7; Lang, 21; Acton, 31; Vincent, 18; Palmdale, 389; Lancaster, 1,010.

The large number at Lancaster was probably due to the fact that this locality is one of the most available for the birds on the Mohave Desert. A representative of the Survey, in cooperation with the boards of horticulture of San Bernardino and Riverside counties, made an examination of the stations along the Southern Pacific Railroad east of Los Angeles and through San Gorgonio Pass, and established the fact that the English sparrow had not yet entered Southern California by this route. He then proceeded along the Santa Fe road from San Bernardino to Barstow, destroying such birds as he found at Victorville. At Barstow, however, he failed to find the English sparrow, either in the railroad yards or about the town. These localities were again visited the first week of April, and sparrows found at Victorville were destroyed, and the presence of the species at Barstow was demonstrated. The colonies were visited a third time in June, and preparations were made to continue the work westward along the Santa Fe Railroad to Mohave and at other points along the coast line of the Southern Pacific between Los Angeles and Ventura.

The results thus far accomplished show that the sparrow colonies in Southern California, though small, are likely to increase and spread, if efforts to extirpate them are not persistent. It is very difficult to destroy every English sparrow in a given locality, and even when this is done new immigrants are likely to come in on the cars. Efforts are therefore directed chiefly toward warning local residents of the danger from the pests and demonstrating the ease with which the colonies, if attended to in time, can be destroyed at moderate expense.

WOODPECKERS.

Woodpeckers are among our most beneficial birds and render important aid in preserving our forests and shade trees by digging out injurious insects from their retreats in the trunks and branches. Much work on the food of this species has been done during the past year, and when certain additional data are obtained a revision of the bulletin on the food of woodpeckers, issued in 1895 and now out of print, will be prepared.

Useful as are most of the members of this group, many complaints are received against the several members of one section of the family. These are the sapsuckers, which habitually dig into the bark of trees for the purpose of obtaining the sap which exudes from the wounds; they eat also the cambium or inner layer of the bark. The injuries thus inflicted sometimes result in the death of the tree. In addition, investigations now in progress show that timber otherwise sound is so injured by stains and distortions, the result of nature's efforts to repair the damage inflicted by the sapsuckers, that its value for manufacturing purposes is seriously impaired. The members of this group, therefore, may properly be exempted from protection.

FLYCATCHERS.

The flycatchers constitute one of the most important groups of insectivorous birds, and contains numerous species whose services to the farmer are of great value. During the year more than 3,000 stomachs of 17 species of flycatchers have been examined preliminary to the preparation of a bulletin on the economic relations of the more important members of the family.

BIRDS IN RELATION TO WHEAT APHIDS.

The so-called green bugs or wheat aphids, a pest introduced from Europe, have done much damage in the grain fields of North Carolina, and early in April an assistant visited Forsyth County to ascertain whether any of our native birds were attacking the insect and to what extent. It was found that several native species of sparrows were resorting in great numbers to the infested fields and were feeding largely on the green bug and other wheat lice. The birds destroyed many thousands of the insects each day, and the effect of their work was to limit the insects' ravages and to save much wheat and other grain which, but for their aid, would have been lost.

SHORE BIRDS.

Substantial progress has been made in studying the food of snipe, sandpipers, and plovers. Among other interesting facts developed it has been ascertained that certain species devour large numbers of mosquito larvæ. They thus effectively supplement the work of fishes in reducing the numbers of these disease-carrying pests, more particularly as they obtain many of the larvæ in isolated pools and shallow water not frequented even by minnows. A bulletin on this group, with special reference to their breeding resorts, their winter homes, and their migration routes, has been completed.

FOOD OF WILD DUCKS.

Investigations of the food of wild ducks have been continued for several years, the chief purpose being to obtain information as a guide to legislation on this important group of birds—important both from the standpoint of the sportsman and as a source of food supply. As certain species of ducks diminish to the point where extinction threatens, they may be preserved either by being bred in a state of partial domestication, or else ponds and streams surrounded by tracts of suitable marshy land may be set apart as duck preserves, where the ducks may resort to breed unmolested. Where other conditions are favorable and only proper feed is wanting, this may be supplied by transplanting various species of aquatic plants. During October and November an assistant visited certain ducking grounds in Wisconsin and Michigan in order to determine the kind of plants on which the ducks of that region chiefly feed. In addition, much information was obtained from hunters and sportsmen, and as a result of the direct relations established with these men, more than 1,200 duck stomachs were secured for examination. A bulletin on the food of ducks is now being prepared.

DISEASES OF WILD DUCKS.

It was learned that the wild ducks of Lake Pequa, Wisconsin, were affected with a disease which each year destroyed several thousand. A number of the dead birds were obtained and turned over to the Bureau of Animal Industry for examination and report. The disease proved to be coccidiosis, which manifests itself by severe inflammation of the intestines. It is caused by a protozoan, and results in imperfect assimilation and often in death by starvation. The organism responsible for the disease is believed to be the same that causes the white diarrhea in chickens. The obvious remedy is to prevent, when possible, the pollution of waters frequented by wild fowl by streams draining farms and poultry yards.

GEOGRAPHIC DISTRIBUTION.

As usual, investigations in this branch of the work covered a wide field and included many States. Vernon Bailey, assisted by C. E. Birdseye and E. A. Goldman, spent several months in New Mexico making collections to define the life zones of the Territory and studying the food habits of its birds and mammals. E. W. Nelson completed a report on the rabbits of North America, which is now published and distributed. Comparatively little has been known of the distribution and the relations of the numerous species of this group of mammals, economically important both as a source of food and because of the great damage they do in various parts of the country.

The biological survey of Utah, begun years ago but dropped on account of more urgent work, was again taken up and carried on for three months by W. H. Osgood. A. H. Howell did much field work in Georgia, Alabama, Mississippi, Tennessee, and South Carolina for the purpose of filling in gaps in our knowledge of the faunas of those States. He also made extensive collections of birds and mammals with reference to life-zone work and investigated the relations of birds to the boll weevil in the recently invaded parts of Mississippi. During the latter part of the year N. Hollister visited certain areas in California and made special studies of the breeding grounds of certain economically important birds. He also made collections of birds and mammals in connection with a general map of the life zones of that State. A report on work in Alaska during the seasons 1903 and 1904, by W. H. Osgood, is now in press.

A large amount of data on the migration of North American birds has been gathered by W. W. Cooke during the year and tabulated for future use. In addition to the above, advance has been made in digesting and arranging for immediate reference the data on the distribution of birds and mammals. Work on the distribution maps has been pushed as rapidly as the exigencies of other and more pressing work permitted.

GAME PROTECTION.

The work of game protection under the various acts of Congress relating to the preservation of birds and game and the importation of birds and mammals into the United States continues to grow in volume and importance. The scope of the work is broadening yearly, and the variety of records necessary as a basis for quick and intelligent action is constantly increasing.

IMPORTATION OF FOREIGN MAMMALS AND BIRDS.

As required by the act of Congress of May 25, 1900, constant supervision has been maintained over the importation of birds and mammals into the United States. In connection with this duty 76 inspections have been made at New York, 4 at Philadelphia, and 13 at Honolulu. Eight starlings, discovered in a bird store in Philadelphia in November, 1908, were turned over to the Philadelphia Zoological Garden. In January, 1909, the same species was refused entry at New York. At Honolulu, April 26, a Japanese merchant applied for a permit to enter a lot of Japanese nuns or bengalees (*Uroloncha acuticauda*) and Java sparrows or ricebirds (*Padda oryzivora*). As these birds have proved destructive in the Orient, the permit was refused and the birds were destroyed. The constant danger of the introduction of the mongoose is emphasized by the killing of one of these pests on Cape Cod in August, 1908, by a farmer whose fowls it was destroying. How it was introduced into the country is unknown.

Owing to efforts to import from Mexico birds the sale and possession of which are prohibited in most States, it was found expedient to require the production of a state permit or other authorization from local officials before permitting entry.

Among the importations under permit the principal interest attaches, as last year, to the introduction of European partridges for stocking game covers, the State of Connecticut being particularly active in this regard. The growth of popularity of this bird for stocking depleted covers is shown by the rapid increase in the number imported—50 in 1904–5, 736 in 1905–6, 3,075 in 1906–7, 7,081 in 1907–8, and 29,832 in 1908–9. About 1,200 pheasants (including 105 pure English pheasants) and 640 Mexican quail were also imported for liberation. Aviary pheasants were imported to the number of 1,100, among which were included 15 Formosan, 16 Prince of Wales, 16 true Mongolian (*Phasianus mongolicus*), 15 black-backed kaleeges, and 2 each of the rare monauls (or impeyan pheasants), Temminck tragopans, and red jungle fowls. The total number of game birds of all kinds brought in was 34,996, an increase of 20,298 over the previous year's figures.

The nongame birds imported comprised 314,170 canaries and 39,699 miscellaneous birds. Among the former were 4,485 Norwich, 60 cinnamon, 12 Belgian, and 24 mule canaries, and 28 Lancashire coppies. Perhaps the most interesting of the miscellaneous birds were 139 shâma thrushes. The greatly increased imports of these fine Indian songsters are largely due to an effort to substitute them for the mockingbird, which can no longer be sold in most States. Other noteworthy importations were 36 Lady Gould finches, 50 East Indian nonpareils, 30 dwarf amadines, 10 silver-eared mesias, 4 dial birds, and one consignment of 500 Indian yellowhammers.

Mammals were imported to the number of 1,179. Of special interest was a consignment of 5 wallabies, 2 opossums, and 4 Tasmanian devils from Tasmania, temporarily placed on exhibition at the Alaska-Yukon-Pacific Exposition.

The number of game-birds' eggs imported was 5,050, of which 1,910 were wild mallard duck eggs, 2,580 pheasant eggs, and 560 partridge eggs.

To these must be added the following imports without permit: Twenty-four thousand and eighty-six canaries, 13,073 parrots, 1,753 miscellaneous birds, and 1,024 mammals, thus making the total importations from July 1, 1908, to June 30, 1909, 338,256 canaries, 89,521 miscellaneous birds, 2,203 mammals, and 5,050 eggs of game birds.

A card index is kept of the species imported, which, when brought up to date, will not only show the number of birds and mammals entering the United States since 1900, but will furnish a serviceable record of the earliest importation of many interesting species. In order to extend its field, the index will be supplemented in special cases by the earlier history of introduction of the species into Europe as well as the United States.

BIRD RESERVATIONS.

During the year the number of bird reservations has more than trebled (having been increased from 16 on July 1, 1908, to 51 on June 30, 1909), and two of the older reservations, Pelican Island and Mosquito Inlet, Fla., have been enlarged. The date of establishment, name, and location of the thirty-six reservations established during the year are as follows:

No.	Date.	Location.	No.	Date.	Location.
17	Aug. 8, 1908	Key West, Fla.	35	Feb. 25, 1909	Strawberry Valley, Utah.
18	do	Klamath Lake, Oreg.	36	do	Keechelus, Wash.
19	Aug. 18, 1908	Lake Malheur, Oreg.	37	do	Kachess, Wash.
20	Aug. 28, 1908	Chase Lake, N. Dak.	38	do	Clealum, Wash.
21	Sept. 15, 1908	Pine Island, Fla.	39	do	Bumping Lake, Wash.
22	Sept. 26, 1908	Palma Sola, Fla.	40	do	Conconully, Wash.
23	do	Matlacha Pass, Fla.	41	do	Pathfinder, Wyo.
24	Oct. 23, 1908	Island Bay, Fla.	42	do	Shoshone, Wyo.
25	Oct. 26, 1908	Loch Katrine, Wyo.	43	do	Minidoka, Idaho.
26	Feb. 3, 1909	Hawaiian Islands, Hawaii.	44	Feb. 27, 1909	Bering Sea, Alaska.
27	Feb. 25, 1909	Salt River, Ariz.	45	do	Tuxedni, Alaska.
28	do	East Park, Cal.	46	do	St. Lazaria, Alaska.
29	do	Deer Flat, Idaho.	47	do	Yukon Delta, Alaska.
30	do	Willow Creek, Mont.	48	do	Culebra, P. R.
31	do	Carlsbad, N. Mex.	49	do	Farallon, Calif.
32	do	Rio Grande, N. Mex.	50	do	Pribilof, Alaska.
33	do	Cold Springs, Oreg.	51	Mar. 2, 1909	Bogoslof, Alaska.
34	do	Bellefourche, S. Dak.			

These reservations may be divided into several groups, according to the kinds of birds protected. They differ in character and size from any of the reservations previously established. Thus Klamath Lake and Lake Malheur reservations in Oregon and the Yukon Delta Reservation in Alaska comprise considerable areas of marshy land that form breeding grounds for wild fowl of various kinds. The Hawaiian Islands reservation, comprising a number of islets in mid-ocean, is one of the largest and most famous breeding colonies of sea birds in the world. It covers 5 degrees of latitude and 20 degrees of longitude. Most of the reservations in the interior in Arizona, California, Idaho, Montana, New Mexico, Oregon, South Dakota, Utah, Washington, and Wyoming are on reservoir sites of reclamation projects. When the reservoirs are completed, many birds will be attracted to them; and the future protection of these birds is the object of making the reserves now.

A case is pending in which the act of June 28, 1906, prohibiting trespass on bird reservations will be tested in the courts. On March 16, 1909, a visitor to Mosquito Inlet Reservation, Fla., despite the warning of the warden, shot and killed 4 pelicans. Complaint was made before the United States commissioner, and the offender was bound over to await the action of the grand jury next December.

It is gratifying to note that 8 of the colonies of birds protected by the Federal Government have already been utilized for special study. On Tortugas Keys, under the direction of the Carnegie Institution of Washington, an elaborate investigation has been begun of the life history of sea birds; problems of migration, the homing instinct, and other features of bird life have been carefully studied, and results of the first year's work have been published. Klamath Lake and Pelican Island reservations, Three Arch Rocks Reservation, Oreg., the three reservations off the coast of Washington, and Breton Island Reservation have recently formed the subjects of articles by ornithologists.

MONTANA BISON RANGE.

In the Agricultural Department appropriation bills for 1909 and 1910 and the general deficiency bill for 1909 (act of May 23, 1908, and two acts of March 4, 1909) provision was made for the purchase of 20,000 acres of land on the Flathead Indian Reservation in Montana for a national bison range, and $13,000 was allowed for fencing, the buffalo to be furnished by the American Bison Society. In furtherance of this project the range was selected by the Chief of the Bureau, in cooperation with an engineer of the Forest Service and the chairman of the commission appointed to allot the lands of the Flathead Indian Reservation. Bids for constructing the fence were called for, but proved too high, so that the Forest Service has undertaken to build the fence. It may be stated that the American Society has already raised $10,500 for the purchase of buffalo, and has the promise of 14 as gifts. It is ready to place a herd of at least 50 buffalo on the reservation as soon as the fencing is completed.

OLYMPIC NATIONAL MONUMENT.

Special protection was afforded elk in Washington by the act of the President in setting aside the higher summits of the Olympics as a national monument. These mountains are the center of the region inhabited by the Roosevelt elk, and protection by setting aside their summer range is necessary to their preservation.

PROTECTION OF GAME IN ALASKA.

The new Alaska game law of May 11, 1908, was given wide publicity throughout the Territory in a circular published August 1, 1908, which contained the text of the law and the departmental restrictions. These regulations have remained unmodified, except for a change in relation to the capture and sale of deer, which was published March 6, 1909. The new law permitted shipment of trophies until September 1, 1908, without permit or license, and under this exemption about 175 trophies were shipped from the Territory, comprising moose, mountain sheep, caribou, brown bears, mountain goats, and deer. Thirty-eight permits were granted for collection and export of specimens. Eighty-one of the specimens exported under these permits, chiefly heads and horns of moose, caribou, and sheep, were shipped to Seattle for exhibition at the Alaska-Yukon-Pacific Exposition. Provision is made by the new law for the employment of game wardens, but in the absence of an appropriation for that purpose for the current year none were appointed. The sundry civil appropriation bill for the year ending June 30, 1910, however, carries an appropriation of $10,000 for warden service, and thus furnishes means for proper enforcement of the law.

INFORMATION CONCERNING GAME.

The increasing number of requests for information concerning game has shown the importance of augmenting the resources of the survey by making additional indexes and summaries. Early in the year effort was begun to systematize the data already collected and to extend the work, particularly by obtaining more definite reports of the amount of game killed, statistics of the abundance of game, and a more complete record of the bills under consideration in State legislatures.

Big game.—In connection with the preliminary investigation of the conservation of natural resources, such statistics as were available were collected respecting the amount of big game killed, the receipts from hunting licenses, and the increased value of land due to the presence of game—in short, the value of game as a natural resource. With a view to the collection of more accurate information in the future, the subject was taken up with several of the State game commissioners, and in two or three instances provisions were incorporated in the game bills requiring hunters to make returns at the end of the season of the number and kind of big game and of game birds killed. But although the game warden departments showed full appreciation of the value of the work, the time was too short to educate the public to the importance of such data, and most of the provisions failed of enactment. Special attention was paid to the collection of data showing the number of deer killed during the season of 1908 and the present numbers of antelope. Through the commissioners of Maine, Vermont, New York, Pennsylvania, South Carolina, Wisconsin, Minnesota, Louisiana, and Colorado, estimates were obtained of the total number of deer killed in those States during the past season, and through correspondence with local observers similar figures were obtained for Michigan, Maryland, West Virginia, Virginia, Alabama, Mississippi, Florida, and California. As a number of States afforded no deer hunting during the season, the estimates collected give for the first time a fair approximation to the total number of deer killed east of the Mississippi (except in New Hampshire, North Carolina, and Georgia) and also in Colorado and the most important counties of California. The total number was about 60,000. This work merits further extension, and it is hoped that soon a complete census can be furnished of the deer killed annually—at least east of the Mississippi.

In the West information concerning the present number of antelope was obtained from various sources. Some of the data were summarized and placed in the hands of persons interested in securing better protection for the species. Correspondence was had with game commissioners and others in several of the States where the season was still open, with a view to giving protection throughout the year. As a result of combined efforts the season was closed for several years in Montana, Wyoming, and Oregon. In Montana this legislation is of special importance from the fact that the Yellowstone National Park herd, part of which winters outside of the park in the vicinity of Gardiner, is in jeopardy so long as the Montana season is open.

During the year details were collected concerning legal restrictions on the hunting of big game in the United States and Canada.

Index of game legislation.—The index of game legislation, begun several years ago, has made good progress during the year, and now promises to be of great value. The game laws of all the States west of the Mississippi are now indexed, and also those of Alabama, Florida, Georgia, Michigan, and West Virginia, making 27 States in all. In addition to these complete indexes, partial ones have been made of the game laws of New York, Virginia, and North Carolina. When the index has been completed for the last decade in all the States, it will furnish interesting data on the relative number and cost of game laws. The United States enacts more game laws than any other country—in some years more than all other countries combined. The value of such legislation is often questioned, and the need of reform has frequently been urged in governors' messages. During the past year three commissions have been appointed—in California, Maryland, and New Jersey—with a view to devising a practicable method to stay the flood of game bills which overwhelms the committees in some State legislatures. The question is important and a satisfactory solution will prevent much waste of time and money.

GAME LAWS OF THE UNITED STATES AND CANADA.—In September, 1908, the usual summary of game laws was published and distributed as Farmers' Bulletin 336; also two posters of close seasons (one general for the United States and Canada and one special for Maryland, the District of Columbia, Virginia, and North Carolina) were issued.

GAME PROTECTION IN 1908.—In the résumé of the year's progress in game protection prepared for the Yearbook, the condition of game, particularly big game, was again made a prominent feature.

DIRECTORY OF GAME OFFICIALS.—The annual circular showing the names and addresses of state game officials and organizations and Audubon societies was issued in August.

STOCKING COVERS.—Many details of transactions in imported game birds and eggs for stocking covers were gathered. The growing scarcity of native game birds gives added importance each year to this phase of the work. Game officials and private preserve owners continued to import European game birds for restocking, the number of Hungarian partridges brought in being particularly large. The eggs of game birds imported consisted chiefly of those of pheasants and wild mallard ducks. These experiments are followed up as closely as possible and a careful record is kept of the results.

PHEASANT RAISING.—Special investigation was made of the propagation of pheasants. A number of pheasantries in New York, New Jersey, and Illinois were visited by a representative of the Survey, and the information secured formed the basis of a report now being prepared.

PRIVATE GAME PRESERVES.—The first part of the information collected regarding private game preserves is nearly ready for publication. It will include deer parks and private preserves stocked with deer and other big game. The data secured comprise the location, area, and date of establishment of each preserve, the character of fencing, the kind of game with which it is stocked, the success in breeding, and other items. It not only will serve as a directory of private preserves, but will in effect provide a census of big game in captivity in the United States, except in zoological gardens, at the close of 1908.

FUR-BEARING ANIMALS.—The various state and national restrictions in force concerning fur-bearing animals were compiled in response to numerous requests from trappers and others interested.

WILD TURKEYS.—Through systematic correspondence statistics were secured from a number of States showing the localities in which wild turkeys still occur and the number killed during the last open season.

DUCKING GROUNDS.—With a view to securing further information on ducking grounds of the United States, the well-known ducking grounds at the head of Chesapeake Bay were visited during the year; much information also was secured concerning those on the Illinois River.

HUNTING ACCIDENTS.—Investigation of the nature and causes of hunting accidents was continued. The data secured have been filed in convenient and readily accessible form as a basis for legislation or other means of preventing such accidents.

HUNTING-LICENSE STATISTICS.—Statistics were secured from Great Britain, France, and Switzerland, showing the receipts for hunting licenses during the past ten years. These are of interest for comparison with similar figures for the United States.

APPROPRIATIONS FOR GAME PROTECTION.—Compilation was made of the state funds set aside for game protection in 1907–8. This information is complementary to the report already published of appropriations for 1905–6.

THANKSGIVING GAME.—The usual data concerning the prices and abundance of game in the markets immediately preceding Thanksgiving Day were gathered.

COOPERATIVE WORK.

Cooperation with state game officials and others interested in game and birds continues to be an important phase of the work. During the year many requests were received that representatives of the Survey be sent to appear before committees of state legislatures in regard to matters relating to the protection of game. Though it was impossible to comply with all these requests, visits were made to New Jersey, Michigan, and Wisconsin. Information was furnished on request to California, Louisiana, Minnesota, Oregon, Texas, and Wyoming. A summary of the entire game legislation of Alabama, covering 108 years, was sent to the game commissioner of that State; and aid was given Virginia in securing better protection for non-game birds through a general awakening of interest in the State.

INTERSTATE COMMERCE IN GAME.

Owing to the construction placed on the marking provisions of the Lacey Act by the federal court of North Dakota and on the state law of Illinois by the attorney-general of that State, together with the unfavorable legislation of the previous year in Missouri, fewer cases than usual involving illegal interstate shipments of game were brought to the attention of the department. These defects, however, have been largely remedied. Through the passage of the penal code, sections 3 and 4 of the Lacey Act were materially strengthened and broadened, and by the enactment of new statutes in Illinois and Missouri at the last legislative sessions the local laws were greatly improved. The importance of the modification of these laws is apparent when it is considered that state laws form the basis of the Lacey Act and that more interstate shipments of game pass through Kansas City, St. Louis, and Chicago than pass through any other cities. After January 1, 1910, when the penal code goes into effect, the Department should be in a position to enforce the Lacey Act much more effectively than heretofore.

The number of new cases arising under the Lacey Act was nine. Of these, six were shipments of game birds from New York to Connecticut, New Jersey, Pennsylvania, and Maryland, originating on information furnished by the Bureau of Animal Industry in connection with the enforcement of the meat inspection act; two involved introduction of prohibited species of mammals and birds; and one arose through unlawful export of game birds from Iowa. The New York cases were referred to the forest, fish, and game commission of New York and prosecuted under the state law. Four resulted in convictions; the other two are still pending. The two cases relating to prohibited species were settled out of court, and the two Iowa cases are still pending. Among the cases pending for several years, one which involved the shipment of 512 quail from Oklahoma, and which had been referred to the Department of Justice in 1905, was decided. The defendant was fined $100 on each of four indictments, or $400 in all.

The following is a list of these cases:

Violations of the Lacey Act arising or settled during the year ending June 30, 1909.

Defendant.	Place.	Offense.	Disposition.
Importer unknown	Philadelphia, Pa	Importation and shipment of 8 starlings in violation of secs. 2 and 3 of Lacey Act.	Settled out of court.
Fischer	Washington, D. C	Importation and shipment of 1 flying fox in violation of secs. 2 and 3.	Do.
Andrew Reuhl	New York	Illegal shipment of 33 ducks	Fine $50; paid.
N. Low & Son	do	Illegal shipment of 2 ducks	Fine $25; paid.
John M. Isemann	do	Illegal shipment of 12 quail	Do.
Samuel Katz	do	Illegal shipment of 2 ducks, 4 quail.	Do.
Steigerwald Packing Co.	do	Illegal shipment of 12 quail	Pending.
Samuel Katz	do	Illegal shipment of 2 ducks	Do.
Paris N. Ruppert	Okeene, Okla	Illegal shipment of 512 quail.	Fine $400; paid.
J. D. Carson	Marion, Iowa	Illegal shipment of 41 prairie chickens.	Pending.

OUTLINE OF WORK FOR 1910.

ECONOMIC ORNITHOLOGY AND MAMMALOGY.

Work on the food habits of birds and mammals will be continued, including the examinations of stomachs and tabulation of their contents.

Field experiments will be continued to determine the best and most economical methods of destroying the California ground squirrel.

Two independent series of experiments will be carried on—one in New Mexico, the other in Wyoming—to determine the cheapest effective poison and the most attractive bait for exterminating prairie dogs.

Field work will be carried on in Arizona, California, Oregon, and Washington in connection with the destruction of gophers, ground squirrels, kangaroo rats, and other burrowing animals which dig into and weaken irrigation embankments and fills.

Preliminary studies of the food habits of the mole will be made in Virginia, Maryland, and the District of Columbia. As many stomachs of the mole as possible will be collected to determine the exact nature of the animal's food and especially to what extent, if any, it eats vegetable food.

Observations on the habits and depredations of the pine mouse will be carried on.

The relation of the food of birds to the fruit industry will be studied in Washington, southeastern California, and the Gila and Salt River valleys of Arizona.

Preliminary studies will be carried on in Massachusetts for the purpose of ascertaining what birds feed upon the gipsy and browntail moths. In connection with this work field observations will be made to ascertain the extent of the mortality among birds caused by the use of spraying solutions of arsenite of lead.

The relation of the continued diminution of waterfowl and shore birds to the food supply will be investigated along the coast line from Massachusetts to South Carolina.

GEOGRAPHIC DISTRIBUTION.

The biological survey of Utah, begun many years ago but discontinued because of lack of funds, will be continued the present year. Considerable work in relation to a life-zone map of North Dakota has already been done. The University of North Dakota has asked the Survey to cooperate with a view to completing and publishing a biological map of the State, and it is hoped that arrangements can be made for cooperation. The biological survey of California, in progress for several years, will be continued. Field work in Colorado has been completed, and in New Mexico will be completed during the present field season and the results published at as early a date as practicable.

GAME PROTECTION.

During the coming year much time will necessarily be occupied in keeping up to date the various current records concerning game and in completing work already begun. The consolidated card index of species imported since the passage of the Lacey Act, May 25, 1900, has progressed far enough to insure its completion. The index of game legislation, which now covers all the States west of the Mississippi and several eastern States, will be pushed as rapidly as possible, and by the end of the year, it is hoped, will be complete for at least the past decade in all the States.

The compilation of the laws relating to fur-bearing animals is practically completed, and will be made the basis of a bulletin during the coming year.

Work will be continued on the index of decisions in cases involving questions relating to game, and will be advanced as far toward completion as pressure of other work will permit.

The various other records maintained by the Survey, relating to game preserves, appropriations for game protection, hunting licenses, statistics of big game, and hunting accidents, will be continued.

As 1910 will complete the first decennial period, not only of the century but also of federal bird and game protection under the

Lacey Act, it is intended to prepare for publication a ten years' review of bird and game protection and of the importation of birds and mammals, including legislation and other phases of the subject. Such a review will serve a useful purpose in showing the progress of the past ten years, its trend, its successes, and its failures.

Certain changes are contemplated in the summary of game laws. When the Department first undertook the publication of tables showing the season for hunting, the game laws of some of the States were incomplete, and it was possible only to follow their provisions and to publish tables showing the periods during which hunting is prohibited. To ascertain the open seasons it was necessary to reverse the dates published by the Department. This inconvenience has long been recognized, and the state laws having been so far perfected as to cover practically all game, a radical departure will be made this year by publishing the open seasons instead of the closed, so that sportsmen, dealers, and others can ascertain at a glance the period of the year when game can be legally hunted or had in possession. In making this change the opportunity will be taken to reexamine carefully all the dates for the various seasons in each State.

As a means of expediting correspondence, experience has demonstrated the need of printing brief circulars on a number of topics concerning which inquiry is frequently made. These can be issued from time to time and can be revised and brought down to date when necessary. Material has already been collected for a condensed circular to contain all the restrictions on big game hunting in the United States and Canada. Other subjects under consideration are spring shooting, statistics of hunting licenses, bag limits, federal bird reservations, game protective organizations, warden service, and provisions of state laws affecting the millinery trade.

Congress having made an appropriation for the maintenance of Federal bird reservations, a readjustment of salaries of wardens will be made, and, as far as funds permit, warden service will be established on reservations not already in charge of wardens.

The increasing use of bird reservations for studying different phases of bird life will be encouraged in every way possible. Besides the work of the Carnegie Institution of Washington at the Tortugas Keys Reservation, other studies are already in prospect. The Bureau of Fisheries is desirous of making certain investigations on the Pribilof Reservation, and arrangements for such cooperation have already been completed. An application has also been received for permission to collect material on Laysan Island, in the Hawaiian Reservation, for installing in the University of Iowa one of the most elaborate bird groups ever undertaken in this country. Warden service will be established on the Montana Bison Range, and every possible precaution will be taken to care for the valuable herd presented to the Government by the American Bison Society. The various projects for game refuges now under consideration will be given thorough examination in order that the Department may be provided with the fullest possible information concerning the details and merits of each.

REPORT OF THE CHIEF OF THE DIVISION OF ACCOUNTS AND DISBURSEMENTS.

U. S. Department of Agriculture,
Division of Accounts and Disbursements,
Washington, D. C., October 25, 1909.

Sir: I have the honor to submit herewith a report of the work of the Division of Accounts and Disbursements for the fiscal year ended June 30, 1909.

Very respectfully,
A. Zappone,
Chief of Division.

Hon. James Wilson,
Secretary of Agriculture.

CHARACTER OF WORK.

The Division of Accounts and Disbursements audits, adjusts, and pays all accounts and claims against the Department; decides questions involving the expenditure of public funds; prepares advertisements for all work and supplies not contracted for by the General Supply Committee of the Executive Departments; prepares letters of authority; writes, for the signature of the Secretary, all letters to the Treasury Department pertaining to fiscal matters; examines and signs requisitions for the purchase of supplies; issues bills of lading and requests for passenger and freight transportation; prepares the annual estimates of appropriations; prepares annual fiscal reports to Congress, and transacts all other business relating to the financial interests of the Department.

ORGANIZATION.

For the purpose of systematizing its work, the Division is divided into six sections, as follows:

Cashier's section.—This section prepares and mails all checks and handles all moneys received and disbursed.

Auditing section A.—This section audits all salary and reimbursement accounts.

Auditing section B.—This section audits all purchase, telegraph and express accounts; also all accounts of the Board of Consulting Scientific Experts.

Bookkeeper's section.—This section keeps all books pertaining to the fiscal affairs of the Department, indexes all accounts, prepares all requisitions on the Treasury for advances of public funds, and has charge of the correspondence with the accounting officers of the Treasury in the settlement of accounts.

MISCELLANEOUS SECTION.—This section has charge of the preparation of the several annual reports to Congress and the audit and administrative examination of the accounts and disbursements of the Forest Service.

FREIGHT AND TRANSPORTATION SECTION.—This section audits all freight accounts and prepares and issues all bills of lading and passenger and freight transportation requests.

WORK OF THE YEAR.

APPROPRIATIONS, EXPENDITURES, ETC.

The total appropriations for the Department for the year ended June 30, 1909, amounted to $14,536,320.19, not including $720,000 and $528,000 appropriated for the several State agricultural experiment stations. Of this sum ($14,536,320.19), $12,902,295.64 was disbursed prior to the close of the year, leaving a balance of $1,634,024.55, nearly all of which is covered by outstanding liabilities. Supplemental accounts for the year 1908 were also paid, amounting to $997,805.92. The unexpended balances for the year 1907, amounting to $1,200,180.81, were finally covered into the Treasury on June 30, 1909.

There were received, audited, and paid 56,288 accounts, amounting to $9,359,808.97 (not including Forest Service). In payment of these accounts 108,886 checks were drawn on the Treasury at Washington and the subtreasuries at New York and at Chicago.

There were also audited and sent to the Treasury Department for payment 1,468 accounts.

LOST CHECKS.

During the year 49 checks were lost in transit through the mails or by the payees.

REQUISITIONS, LETTERS, AND REQUESTS.

One hundred and seven requisitions were drawn on the Treasury, aggregating $10,264,803.84 (this does not include Forest Service).

The number of requisitions issued for supplies was 20,636.

The number of letters of authorization for travel was 4,101.

The number of letters written and received in the ordinary transaction of business was about 75,750.

The number of requests for passenger transportation was 24,687.

The number of requests on the Quartermaster-General for the transportation of Government property was 1,201.

The number of departmental bills of lading issued was 1,626.

NEW BUILDINGS FOR DEPARTMENT.

Of the $1,500,000 appropriated by Congress for new buildings there has been expended $1,498,748.90, leaving a balance on June 30, 1909, of $1,251.10.

TEMPORARY SPECIAL DISBURSING AGENTS.

Seventy-two temporary special disbursing agents were active during the year, and the sum of $4,435,022.49 from the appropriations of the Department was advanced to them, requiring the issuance of 321 requisitions upon the Treasury. The total number of temporary special disbursing agents shown includes 55 for Forest Service, to whom $4,219,865.69 was advanced, requiring 239 requisitions upon the Treasury. All accounts of temporary special disbursing agents of this Department were given an administrative examination in this Division before being forwarded to the Treasury Department for final audit and settlement.

MILEAGE BOOKS.

During the fiscal year 570 mileage books were purchased for official use by employees of this Department, at a cost of $21,957.17. Rebates on these books, amounting to $3,347.75, were deposited in the Treasury to the credit of the appropriations.

COMBINED ACCOUNTS.

There were 3,712 combined accounts handled during the fiscal year 1909, and it is estimated that the preparation of at least 22,272 checks was thereby avoided, to say nothing of the saving in clerical labor.

APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES FOR THE FISCAL YEAR 1909.

The table following shows for the fiscal year the amounts appropriated, disbursed, and unexpended:

Appropriations, disbursements, and unexpended balances for the fiscal year 1909.

Object.	Total amount appropriated.	Amount disbursed.	Balance of appropriation on hand.
Salaries, Department of Agriculture, officers and clerks $879,660	$887,260.00	$857,714.32	$21,945.68
Salaries, extra labor 7,600		7,410.85	189.15
Contingent expenses	86,200.00	79,017.79	7,182.21
Library	15,500.00	11,535.83	3,964.17
Bureau of Animal Industry:			
General expenses (including $150,000, deficiency act, Feb. 9, 1909, and $150,000 by deficiency act, Mar. 4, 1909) $1,247,200	1,297,200.00	1,164,186.71	83,013.29
Animal breeding and feeding 50,000		44,817.57	5,182.43
Meat inspection (permanent appropriation)	3,000,000.00	2,848,818.38	151,181.62
Eradicating cattle ticks, 1909	225,000.00	192,528.67	32,471.33
Eradicating cattle ticks, 1908 and 1909	25,000.00	25,000.00	(a)
Bureau of Plant Industry:			
General expenses, 1909	886,266.00	810,846.00	75,420.00
General expenses, 1908 and 1909	10,000.00	8,589.32	1,410.68
Purchase and distribution of valuable seeds. $205,000	258,000.00	194,020.57	10,979.43
Foreign seed and plant introduction 53,000		45,492.56	7,507.44
Paper tests	10,000.00	7,472.52	2,527.48
General expenses, 1909 and 1910	50,000.00	17,366.47	32,633.53
Bureau of Chemistry:			
Laboratory (including $100,000, deficiency act, Feb. 9, 1909)	860,000.00	612,495.42	247,504.58
Bureau of Soils:			
Soil investigations	200,000.00	190,224.94	9,775.06

[a] Exhausted.

Appropriations, disbursements, and unexpended balances for the fiscal year 1909—Cont'd.

Object.	Total amount appropriated.	Amount disbursed.	Balance of appropriation on hand.
Bureau of Entomology:			
Entomological investigations, 1909	$148,800.00	$139,380.22	$9,419.78
Entomological investigations, 1908 and 1909	10,000.00	9,451.81	548.19
Preventing spread of moths, 1908 and 1909	250,000.00	217,569.44	32,430.56
Bureau of Biological Survey:			
Biological investigations	54,420.00	51,117.29	3,302.71
Division of Publications:			
Publications [a]	40,000.00	38,867.69	1,132.31
Bureau of Statistics:			
Collecting agricultural statistics	125,000.00	114,028.11	10,971.89
Office of Experiment Stations:			
Agricultural experiment stations ($843,000)[b] $30,000	123,000.00	28,518.46	1,481.54
Farmers' institutes 10,000		8,359.83	1,640.17
Station at Alaska 26,000		26,000.00	(c)
Station at Hawaii 26,000		26,000.00	(c)
Station at Porto Rico 26,000		26,000.00	(c)
Station at Island of Guam 5,000		5,000.00	(c)
Nutrition investigations	7,000.00	6,993.53	6.47
Irrigation investigations	150,000.00	143,465.23	6,534.77
Office of Public Roads:			
Public roads inquiries $73,000	75,000.00	67,828.09	5,171.91
Rent and repairs 2,000		1,833.33	166.67
Total	8,793,646.00	8,027,950.95	765,695.05
WEATHER BUREAU.			
Salaries	202,510.00	202,142.73	367.27
Fuel, lights, and repairs	10,000.00	8,266.67	1,733.33
Contingent expenses	11,000.00	9,964.55	1,035.45
Salaries, station employees	586,750.00	585,564.89	1,185.11
General expenses	852,000.00	496,107.93	355,892.07
Total	1,662,260.00	1,302,046.77	360,213.23
FOREST SERVICE.			
Salaries, officers and clerks	144,300.00	143,464.87	835.13
General expenses	3,151,900.00	2,821,162.56	330,737.44
Improvement of the National Forests	600,000.00	501,903.96	98,096.04
Naval stores industry	10,000.00	8,949.32	1,050.68
National bison range (including $3,000, deficiency act, Mar. 4, 1909)	43,000.00	219.60	42,780.40
Total	3,949,200.00	3,475,700.31	473,499.69
Total of all regular appropriations for entire Department	14,405,106.00	12,805,698.03	1,599,407.97
SPECIAL APPROPRIATIONS.			
Pomological investigations, fund from sale of fruits and vegetables, balance July 1, 1908	768.12	768.02	.10
Buildings, Department of Agriculture ($1,500,000):			
Balance available on July 1, 1908	30,294.33	29,043.23	1,251.10
Cooperative work, forest investigations	45,978.88	26,687.63	19,291.25
Refunds to depositors, excess of deposits	54,172.86	40,098.73	14,074.13
Grand total of all appropriations available for Department for fiscal year 1909	14,536,320.19	12,902.295.64	1,634,024.55

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[a] Congress also appropriated in the sundry civil bill for printing and binding, $460,000.

[b] This includes $720,000 for state experiment stations under the regular appropriation, to be paid through the Treasury Department. Congress also appropriated $528,000 as a permanent appropriation for State experiment stations under the Adams bill to be paid through the Treasury Department. Total to be paid through the Treasury Department for State experiment stations, $1,248,000.

[c] Exhausted.

MONTHLY CHECK STATEMENTS.

The check statements submitted by the Treasury and subtreasuries were compared with the checks issued by this Division, and the amounts verified.

ANNUAL SUPPLIES.

Awards for all ordinary annual supplies for the use of this Department during the fiscal year 1910 were made by the General Supply Committee of the Executive Departments, and it was therefore necessary for the Department of Agriculture to advertise independently for only those supplies of a technical character which are used by this Department exclusively, and which, for that reason, were designedly omitted from the general schedule. The awards made for these technical supplies were, as heretofore, based upon bids received through advertisement in the columns of the daily newspapers in the large cities and special mail notifications to all of the well-known dealers in the wares required, the bids, when received, being submitted to and passed upon by a board of award acting under the instructions and by the authority of the Secretary. Although supplies aggregating an amount less than $50 may, under the act of March 1, 1899, be purchased in the open market, all supplies, as far as practicable, were regularly advertised for either directly by the Department or through the General Supply Committee.

PUBLIC MONEYS RECEIVED FROM VARIOUS SOURCES.

There were received from various sources and deposited in the Treasury to the credit of the proper funds the following sums:

Miscellaneous receipts, sales of condemned property, etc	$10,268.12
Telegraph-line receipts, Weather Bureau	1,732.70
Sales of products, agricultural station, Hawaii	321.76
Sales of products, agricultural station, Porto Rico	2,470.23
Sales of products, agricultural station, Alaska	1,154.84
Sales of products, agricultural station, Guam	6.00
Total	15,953.65

In this connection it is thought desirable to explain the method pursued in receiving and disposing of the moneys pertaining to the several funds.

The proceeds of "condemned property," "library index cards," and "card index of agricultural literature" prepared by the Office of Experiment Stations are covered into the Treasury to the credit of "Miscellaneous receipts," under section 3618 of the Revised Statutes.

Moneys derived from the sales of products at the insular stations in Hawaii, Porto Rico, Alaska, and Guam are used for the maintenance of those stations.

Up to June 30, 1907, the moneys derived from the sales of "publications" issued by the Weather Bureau were deposited in the Treasury to the credit of the appropriation "General expenses" of that Bureau, under section 227 of the Revised Statutes. Since July 1, 1907, these moneys have been deposited to "Miscellaneous receipts," in accordance with the provision in the act making appropriations for this Department for the fiscal year ending June 30, 1908. (34 Stat. L., p. 1258.)

"Seacoast telegraph line receipts" are covered into the Treasury under act of March 3, 1883. (22 Stat. L., 616.)

In acknowledgment of each deposit of funds the Treasurer issues to the depositor a duplicate certificate of deposit. The number of this certificate is entered as part of the transaction, and the certificate is filed in this Division.

These moneys are forwarded to the Division of Accounts and Disbursements from the various Bureaus, Divisions, and Offices of the Department, accompanied by a letter, or specially printed form, in duplicate, explaining from whence the money was derived. The duplicate is receipted by the Chief of this Division and returned to the sender. The original is placed in the files of this Division as a voucher. The amount received is entered in a book with a description of the transaction copied from the letter of transmittal. If in the form of cash or postal money order, it is so stated in the entry, and if by check or draft a minute description is given, with name of payor, payee, indorser, name of bank, number and date of check, etc. The law requires that money so received shall be deposited in the Treasury within thirty days after its receipt by a Government officer. The practice in this office is to deposit all sums as soon as practicable after they are received, unless of an insignificant amount. The Chief of this Division, having no authority to do otherwise, accepts the statements accompanying sums of money submitted to him, assuming them to be in strict accordance with the facts.

ACCOUNTS FOR THE FISCAL YEAR 1907 FINALLY CLOSED.

As required by section 5, legislative act, approved June 20, 1874 (18 Stat. L., 110–111), the unexpended balances of the appropriations for the year 1907 were finally covered into the Treasury on June 30, 1909, and carried to the surplus fund, as follows:

Amount of unexpended balances for fiscal year 1907 turned into the Treasury.

Object.		Amount appropriated.	Amount disbursed.	Amount unexpended.
Salaries, Department of Agriculture, officers and clerks (including $1,300, deficiency act, March 4, 1907)	$750,170	$757,770.00	$731,284.77	$18,885.23
Salaries, extra labor	7,600		6,430.73	1,169.27
Contingent expenses		37,000.00	36,603.13	396.87
Library		10,000.00	9,518.47	481.53
Bureau of Animal Industry:				
General expenses	$809,700	862,200.00	745,546.97	64,153.03
Rent of buildings	2,500		2,481.00	19.00
Southern dairy work	20,000		17,762.01	2,237.99
Diseases of domestic animals, Minnesota	5,000		1,691.76	3,308.24
Animal breeding and feeding	25,000		24,361.92	638.08
Meat inspection		3,000,000.00	2,163,907.68	836,092.32
Eradicating cattle ticks		82,500.00	81,328.30	1,171.70
Bureau of Plant Industry:				
General expenses	$478,960	495,260.00	470,158.84	8,801.16
Rent and repairs	11,300		11,216.75	83.25
Ozark Mountain investigations	5,000		4,993.44	6.56
Grain investigations		15,000.00	14,903.23	96.77
Improving roads, Department of Agriculture		3,500.00	3,474.10	25.90
Purchase and distribution of valuable seeds	$205,140.00	242,920.00	201,004.98	4,135.02
Foreign seed and plant introduction	35,781.21		33,834.64	1,946.57
Erection of building at Chico, Cal	1,998.79		1,998.79	(a)
Cotton boll weevil investigations, 1907		105,000.00	101,832.47	3,167.53
Cotton boll weevil investigations, 1907 and 1908		40,000.00	39,999.63	.37
Bureau of Chemistry:				
Laboratory		145,920.00	142,174.00	3,746.00
Enforcement of the food and drugs act		250,000.00	100,279.95	149,720.05
Bureau of Soils:				
Soil investigations	$181,000	185,000.00	179,910.62	1,089.38
Rent of buildings	4,000		3,920.00	80.00
Bureau of Entomology:				
Entomological investigations	70,000	75,000.00	69,114.27	885.73
White fly investigations	5,000		4,902.34	97.66
Cotton boll weevil investigations		85,000.00	64,873.54	20,126.46
Preventing spread of moths		82,500.00	81,993.24	506.76

[a] Exhausted.

Amount of unexpended balances for fiscal year 1907 turned into the Treasury—Continued.

Object.		Amount appropriated.	Amount disbursed.	Amount unexpended.
Bureau of Biological Survey:				
Biological investigations		$44,420.00	$43,975.22	$444.78
Division of Publications:				
Publications, Farmers' Bulletins	$98,750	132,250.00	98,601.18	148.82
Artists, etc	3,500		3,387.46	112.54
Labor, etc	30,000		29,836.21	163.79
Bureau of Statistics:				
Collecting agricultural statistics	108,000	112,900.00	105,466.40	2,533.60
Foreign markets investigations	4,900		4,852.95	47.05
Office of Experiment Stations:				
Agricultural experiment stations ($803,500) [a]	25,500	83,500.00	697,210.54	48,289.46
Farmers' institutes	5,000		4,765.85	234.15
Station at Alaska, including $3,000 for purchase of live stock	18,000		17,987.49	12.51
Station at Hawaii, including $5,000 for water supply	20,000		19,998.75	1.25
Station at Porto Rico	15,000		15,000.00	(b)
Nutrition investigations		20,000.00	19,990.99	9.01
Irrigation investigations		122,200.00	121,638.29	561.71
Office of Public Roads:				
Public-road inquiries		57,660.00	56,833.94	826.06
Total		7,047,500.00	6,591,046.84	1,176,453.16
WEATHER BUREAU.				
Salaries		194,690.00	193,918.11	771.89
Fuel, lights, and repairs		10,000.00	9,928.49	71.51
Contingent expenses		10,000.00	9,912.56	87.44
Salaries, station employees		541,550.00	540,702.30	847.70
General expenses		630,000.00	616,415.03	13,584.97
Buildings		53,000.00	51,727.28	1,272.72
Total		1,439,240.00	1,422,603.77	16,636.23
FOREST SERVICE.				
Salaries, officers and clerks		112,860.00	112,133.16	726.84
General expenses	$849,640	887,140.00	849,265.94	374.06
Rent	35,000		29,050.36	5,949.64
Building on Dismal River Forest Reserve	2,500		2,475.22	24.78
Wichita Forest and Game Preserve		15,000.00	14,999.00	1.00
Total (regular appropriations)		1,015,000.00	1,007,923.68	7,076.32
Pomological investigations, fund from sale of fruits and vegetables		3,744.74	3,744.64	.10
Grand total		9,505,484.74	9,025,318.93	1,200,165.81

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[a] This includes $720,000 for state experiment stations paid through the Treasury Department.
[b] Exhausted.

NOTE.—General expenses, Weather Bureau, $15 for 1906 and prior years, also covered into surplus fund with funds of fiscal year 1907.

BUILDINGS RENTED IN THE DISTRICT OF COLUMBIA.

The following statement shows the buildings under rent in the District of Columbia on June 30, 1909:

Buildings rented in the District of Columbia.

Location of buildings.	For what purpose used.	Annual rental.
Nos. 1224–1226 B street sw	Bureau of Animal Industry, offices and storage purposes.	$720
Rooms 914 and 915 Munsey Building	Bureau of Animal Industry, offices	420
Rear of 1228 C street sw	Bureau of Animal Industry, stable	144
Atlantic Building	Forest Service, offices	24,805
No. 913 E street nw	Forest Service, carpenter shop	270
No. 215 Thirteenth street sw	Division of Publications, document rooms	5,000
No. 201 Thirteenth street sw	Office of Chief Clerk, offices and laboratories	360
No. 203 Thirteenth street sw	do	420
No. 205 Thirteenth street sw	do	420

Buildings rented in the District of Columbia—Continued.

Location of buildings.	For what purpose used.	Annual rental.
No. 207 Thirteenth street sw	Office of Chief Clerk, offices and laboratories	$420
No. 207½ Thirteenth street sw	do	420
No. 209 Thirteenth street sw	do	420
No. 224 Twelfth street sw	do	2,500
Nos. 1304–1306 B street sw	Office of Chief Clerk, offices, laboratories and storage rooms.	2,500
Nos. 1308–1310 B street sw	do	360
Nos. 221–223 Linwood place sw	Bureau of Plant Industry, seed building	4,800
No. 206 Fourteenth street sw	Bureau of Chemistry, offices and laboratories	180
No. 208 Fourteenth street sw	do	120
No. 240 Fourteenth street sw	do	420
Three apartments in The Fairfax	do	900
No. 1362 B street sw	do	1,800
Nos. 200–202 Fourteenth street sw	do	2,500
Stable, lot 27, square 231	Bureau of Chemistry, storage purposes	96
No. 207 Thirteen-and-a-half street sw	Bureau of Chemistry, offices and storage rooms	300
No. 212 Thirteenth street sw	Bureau of Chemistry, offices and laboratories	660
No. 1358 B street sw	do	750
Nos. 210–212 Fourteenth street sw	Bureau of Chemistry, shed for machinery	240
No. 228½ Thirteen-and-a-half street sw	Bureau of Chemistry, storing food samples	300
No. 216 Thirteenth street sw	Bureau of Chemistry, laboratories and offices	16,000
No. 237 Fourteenth street sw	Office of Public Roads, offices and laboratories	2,000
Total		70,245

ESTIMATES OF APPROPRIATIONS.

The estimates of appropriations for the year ending June 30, 1910, were prepared in this Division, based upon recommendations made by the Chiefs of the several Bureaus and Divisions, and after receiving the approval of the Secretary were forwarded to the Treasury in accordance with statutory requirements.

APPROPRIATIONS AND ESTIMATES FOR 1910.

Estimates for 1910.

Salaries, Office of Secretary	$154,700	
Emergency roll	7,600	
		$162,300
Weather Bureau:		
Salaries, office of chief of Bureau		204,310
Fuel, lights, and repairs		25,000
Contingent expenses		
Salaries, station employees		1,412,950
General expenses		
Bureau of Animal Industry:		
Salaries		115,100
General expenses		1,043,760
Animal feeding and breeding		50,000
Eradicating cattle ticks		300,000
Bureau of Plant Industry:		
Salaries		189,950
General expenses		1,127,006
Purchase and distribution of valuable seeds	197,680	
Foreign seeds	46,000	
		243,680
Forest service:		
Salaries		60,200
General expenses		4,956,319
Improvements of the National Forests		974,981
Bureau of Chemistry:		
Salaries		83,240
Laboratory		916,760

Bureau of Soils:		
Salaries		$34,500
Soil investigations		252,600
Bureau of Entomology:		
Salaries		27,880
Entomological investigations		199,800
Preventing spread of moths		300,000
Bureau of Biological Survey:		
Salaries		13,000
Biological investigations		90,170
Division of Accounts and Disbursements:		
Salaries		56,090
Division of Publications:		
Salaries		141,980
Publications, Department of Agriculture		70,000
Bureau of Statistics:		
Salaries		104,580
Collecting agricultural statistics		136,200
Library:		
Salaries		20,160
General expenses		16,500
Miscellaneous:		
Contingent expenses		70,000
Paper making		15,000
Office of Experiment Stations:		
Salaries		39,480
Agricultural experiment stations, to be disbursed by the Treasury Department		720,000
General expenses	$34,800	
Farmers' institutes	10,000	
Station at Alaska	28,000	
Station at Hawaii	28,000	
Station at Porto Rico	28,000	
Station at Guam	15,000	
		143,800
Nutrition investigations		10,000
Irrigation investigations		156,880
Office of Public Roads:		
Salaries		16,210
Public road inquiries Rent		110,240
Total of agricultural bill, which includes $720,000 for agricultural experiment stations, to be disbursed by Treasury Department		14,610,626
Permanent appropriations:		
Meat inspection, Bureau of Animal Industry		3,000,000
Agricultural experiment stations (Adams Act)		624,000
Appropriation in sundry civil bill:		
Printing and binding		510,000
Grand total of all appropriations for the Department of Agriculture		18,744,626

Appropriated for 1910.

Salaries, Department of Agriculture (not including Forest Service and Weather Bureau)		$1,066,360.00
Officers and clerks	$1,058,760	
Extra labor	7,600	
Contingent expenses		80,000.00
Library		16,500.00
Paper tests, 1910		10,000.00
Allotted to Bureau of Plant Industry	5,000	
Allotted to Forest Service	5,000	
Buildings, Department of Agriculture ($1,500,000), balance available July 1, 1909		1,251.10

Paper tests ($10,000), balance available July 1, 1909		$2,527.48
Bureau of Animal Industry:		
General expenses		1,263,760.00
Inspection and quarantine	$625,000	
Eradicating cattle ticks	250,000	
Dairy industry	149,000	
Animal husbandry	43,000	
Diseases of animals	109,000	
Purchase of land for experiment station	25,000	
Administrative expenses	62,760	
Cooperative experiments in animal feeding and breeding		50,000.00
Meat inspection (permanent appropriation)		3,000,000.00
Bureau of Plant Industry:		
General expenses, 1909–10 (appropriated $50,000), balance available July 1, 1909		32,633.53
General expenses, 1910		1,130,796.00
Pathological laboratory	$22,470	
Fruit diseases	34,700	
Forest pathology	17,340	
Cotton and truck diseases	13,060	
Crop physiology	27,290	
Bacteriology and nutrition	25,070	
Crop acclimatization	17,990	
Drug and other plants	43,420	
Crop technology	13,030	
Cotton standardization	12,250	
Grain standardization	52,440	
Physical investigations	15,510	
Special seeds and plants	11,550	
Seed-testing laboratories	25,840	
Grain investigations	63,910	
Tobacco investigations	23,180	
Cotton breeding	18,130	
General plant breeding	14,840	
Paper plant investigations	10,000	
Alkali and drought resistant plants	17,550	
Sugar plant investigations	24,300	
Taxonomic and range investigations	18,250	
Farm management	133,000	
Farmers' cooperative demonstration work	175,000	
Dry land agriculture	31,760	
Western agricultural extension	76,680	
Pomological investigations	71,360	
Experimental gardens and grounds	19,230	
Arlington Farm and horticulture	38,470	
Florida subtropical garden	5,100	
South Texas garden	9,100	
Administrative and miscellaneous	48,976	
Purchase and distribution of valuable seeds		317,960.00
Congressional seed distribution	262,320	
Forage crop investigations	10,000	
Foreign seed and plant introduction	45,640	
Bureau of Chemistry:		
General expenses		805,000.00
Laboratory, miscellaneous expenses	30,000	
Laboratory, transportation	6,300	
Laboratory, salaries and rent	76,240	
Laboratory, American food products	5,000	
Food and drugs act, salaries in Washington	200,000	
Food and drugs act, salaries out of Washington ($266,460)	226,460	
Food and drugs act, miscellaneous expenses ($136,000)	120,000	
Food and drugs act, transportation ($85,000)	81,000	
Allotted to Referee Board:		
Food and drugs act, salaries out of Washington	40,000	
Food and drugs act, miscellaneous expenses	16,000	
Food and drugs act, transportation	4,000	

Bureau of Soils:		
General expenses		$197,360.00
Soil laboratory investigations	$48,000	
Soil water investigations	5,000	
Soil survey	137,360	
Administrative expenses	7,000	
Bureau of Entomology:		
General expenses		198,400.00
Deciduous fruit insects	46,600	
Cereal and forage insects	21,000	
Southern field crop insects	42,000	
Forest insects	12,000	
Truck crop and stored product insects	16,250	
Bee culture	10,000	
Citrus fruit insects	16,500	
Miscellaneous insects	34,050	
Preventing spread of moths		300,000.00
Bureau of Biological Survey:		
General expenses		74,420.00
Game preservation	9,420	
Maintenance of mammal and bird reservations	7,000	
Food habits of birds and mammals	25,000	
Biological investigations	18,000	
Administrative expenses	15,000	
Division of Publications:		
General expenses		33,000.00
Rent in Washington	5,000	
Labor-saving machinery, etc	5,000	
Stationery and materials	11,500	
Furniture and fixtures	1,000	
Photographic equipment	5,000	
Gas, electricity, etc	1,500	
Wagons, horses, etc	1,000	
Miscellaneous expenses	3,000	
Bureau of Statistics:		
General expenses		117,060.00
Administrative expenses	25,860	
Special field agents	56,000	
State statistical agents	30,200	
Special investigations	2,500	
Cost production farm products	2,500	
Office of Experiment Stations:		
Agricultural Experiment Stations ($863,800)[a]		143,800.00
Agricultural experiment stations	34,800	
Farmers' institutes	10,000	
Station at Alaska	28,000	
Station at Hawaii	28,000	
Station at Porto Rico	28,000	
Station at Island of Guam	15,000	
Nutrition investigations		10,000.00
Irrigation investigations		75,000.00
Drainage investigations		81,160.00
Office of Public Roads:		
General expenses		100,000.00
Road management	18,000	
Investigating road building and maintenance	34,000	
Road material	25,000	
Reports of investigations	23,000	
Total		9,106,988.11

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[a] This includes $720,000 for state experiment stations under the regular appropriation, to be paid through the Treasury Department. Congress also appropriated $624,000 as a permanent appropriation for state experiment stations under the Adams bill, to be paid through the Treasury Department. Total to be paid through the Treasury Department for state experiment stations, $1,344,000. Congress also appropriated in the sundry civil bill for printing and binding $460,000.

WEATHER BUREAU.

Salaries		$205, 310. 00
Contingent expenses		25, 000. 00
General expenses		1, 277, 950. 00
Station salaries	$620, 750	
Miscellaneous expenses	91, 000	
Instruments, etc	30, 000	
Rents and repairs	80, 000	
Traveling expenses	22, 000	
Telephoning and telegraphing	260, 000	
Line and cable repairs	4, 200	
Investigations and substations	125, 000	
Printing office	45, 000	
Total		1, 508, 260. 00

FOREST SERVICE.

Salaries, officers and clerks	$60, 200. 00
General expenses	3, 986, 000. 00
Improvement of the National Forests	600, 000. 00
National bison range (appropriated $43,000), balance available July 1, 1909	42, 780. 40
Naval stores industry ($10,000), balance available July 1, 1909	1, 050. 68
Total	4, 690, 031. 08
Total of all regular and special appropriations for entire Department	15, 305, 279. 19

It will be seen from the foregoing that as compared with those for previous years, the appropriations for 1910 show a more elaborate division of the general lump sum appropriations into specific subappropriations. This plan has been adopted in the preparation of the annual estimates to meet the wishes of the agricultural appropriation committees and in order that Congress may be more definitely informed regarding the proposed expenditures of the Department under the numerous projects and investigations under way.

FISCAL AFFAIRS OF THE FOREST SERVICE.

For the purpose of having a record of all the fiscal affairs of the Department in one report, so that it may be of easy reference to the Secretary and others interested therein, the following statement, furnished by the fiscal agents of the Forest Service, is printed:

Statement of the fiscal transactions of the Forest Service.

Number of requisitions issued for the purchase of supplies	2, 932
Number of letters of authorization issued for travel, etc	3, 224
Number of accounts paid during the fiscal year 1909, including those paid from the cooperative fund	32, 111
Total amount paid from the appropriation for the fiscal year 1909, including the cooperative fund	$3, 545, 572. 54
Total amount of supplemental accounts paid from the appropriations for the fiscal year 1908, from July 1, 1908, to June 30, 1909	$924, 655. 34
Number of checks drawn during the period July 1, 1908, to June 30, 1909, in payment of fiscal year 1908 and 1909 accounts	56, 910
Number of passenger transportation requests issued (partly estimated)	9, 786
Number of Quartermaster's Department and departmental bills of lading for freight transportation (partly estimated)	1, 591

Amount of money received from sale of condemned Government property		$191.12
Number of accounts forwarded to the Treasury Department for direct settlement:		
(*a*) Fiscal year 1907	89	
(*b*) Fiscal year 1908	449	
(*c*) Fiscal year 1909	512	
		1,050
Number of checks lost in transit through the mails or by the payee		49
Number of letters written and received in the ordinary transaction of business:		
(*a*) Written		23,861
(*b*) Received		18,870
Amount of money received from timber sales, grazing, etc		$1,807,270.66
Amount of money received from cooperative work		$40,428.74
Number of requests drawn on the Treasury Department for advances of public funds, on account of temporary special disbursing agents, district fiscal agents, and the fiscal agent		239
Number of temporary special disbursing agents appointed during the year		8
Number of district fiscal agents appointed during the year		9
Number of warrants issued for the advance of public funds for temporary special disbursing agents and district fiscal agents		244
Amount of above warrants		$4,219,865.69

ANNUAL REPORT OF EXPENDITURES.

A classified statement of the expenditures of the Department for the fiscal year ended June 30, 1909, was prepared in accordance with law and submitted to the Committee on Expenditures. A recapitulation of the expenditures of the Department will be found below, classified as required by the committee:

Recapitulation of the several appropriations for the entire Department of Agriculture as distributed among the following groups, and the total expenditures under each.

Statutory salaries	$1,210,737.77
Lump fund salaries in Washington	1,521,209.30
Lump fund salaries outside of Washington	7,055,385.75
Stationery	134,547.18
Miscellaneous supplies and services, equipment, books, machinery, etc	1,525,981.73
Furniture	66,862.13
Fuel	30,351.82
Freight	39,759.79
Express	20,165.90
Telegraph	178,339.85
Telephone	37,286.51
Rent	235,193.80
Gas and electricity	26,749.89
Apparatus, instruments, and laboratory material	152,112.95
Printing and binding	4,559.17
Travel and station and field expenses	1,110,366.51
Total	13,349,610.05

Total appropriations for Department of Agriculture		$14,911,206.84
Total expenditures under above groups	$13,349,610.05	
Advances to temporary special disbursing agents	259,069.69	
Forest Service refunds:		
To depositors, excess deposits	40,098.73	
Payments to Uinta Indians	5,348.07	
Payments to States, 25 per cent of receipts	444,379.00	
Federal cooperative disbursements under Forest Service	542.78	
Total expenditures of entire Department of Agriculture		14,099,048.32
Unexpended balance on August 31, 1909		812,158.52
Of this amount there was available for further disbursement:		
Until used	$3,764.45	
During fiscal year 1910	32,633.53	
		36,397.98
Balance		775,760.54
Repayments to credit of appropriations		29,574.62
Net unexpended balance on August 31, 1909		805,335.16
Outstanding liabilities (estimated)		537,593.27
Balance to be turned back into Treasury (estimated)		267,741.89

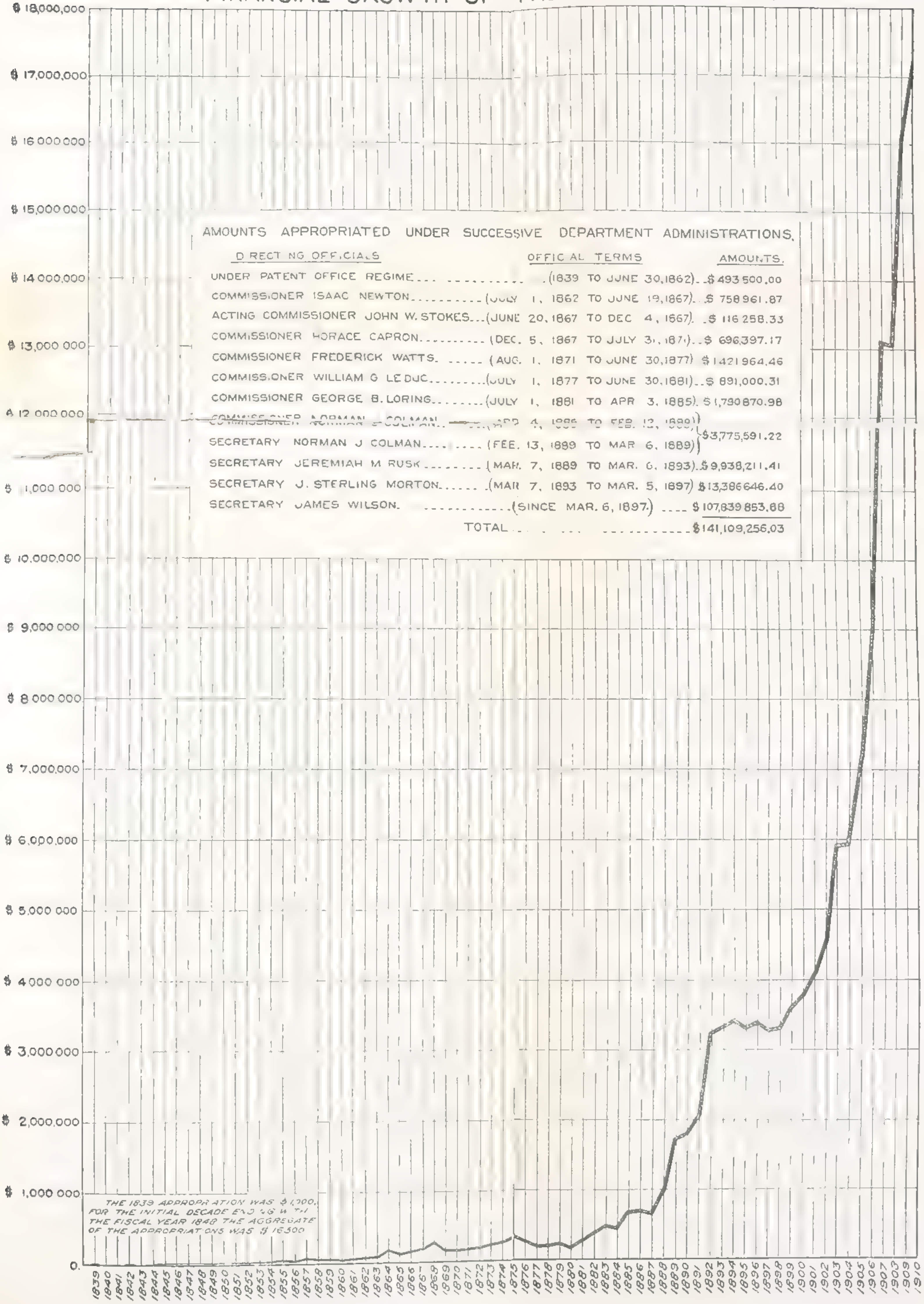
INSPECTION WORK.

By the terms of the agricultural appropriation act for the fiscal year 1909 there was imposed upon the Chief of the Division of Accounts and Disbursements the additional duty of acting as administrative officer of the fiscal affairs of the Department. In compliance with this provision of law and additional instructions from the Secretary, the disbursing officer has, at stated intervals during the year, conducted inspections of the property and financial records kept by the several bureaus of the Department. A uniform system for the keeping of these records has been devised and installed throughout the Department as far as practicable, and the system inaugurated has done much to simplify the financial transactions between the several bureaus and the disbursing office.

CONDITION OF WORK IN THE DIVISION.

The work of the Division is up to date, but to keep it so has taxed to the utmost the energies of the clerical force. In the appropriation act for 1910 Congress has provided several new clerks for the Division, but even with this additional force it will be difficult to keep the work from falling behind in view of the additional demands upon the Division on account of the increasing appropriations, the subdivision thereof, the preparation of several fiscal reports for Congress, the property and financial inspections in the various bureaus, and the administrative examinations of the accounts and disbursements of the Forest Service.

FINANCIAL GROWTH OF THE DEPARTMENT.



THE 1839 APPROPRIATION WAS $1,000. FOR THE INITIAL DECADE ENDING WITH THE FISCAL YEAR 1848 THE AGGREGATE OF THE APPROPRIATIONS WAS $16500

AMOUNTS APPROPRIATED UNDER SUCCESSIVE DEPARTMENT ADMINISTRATIONS.

DIRECTING OFFICIALS	OFFICIAL TERMS	AMOUNTS.
UNDER PATENT OFFICE REGIME	(1839 TO JUNE 30, 1862)	$ 493 500.00
COMMISSIONER ISAAC NEWTON	(JULY 1, 1862 TO JUNE 19, 1867)	$ 758 961.87
ACTING COMMISSIONER JOHN W. STOKES	(JUNE 20, 1867 TO DEC 4, 1667)	$ 116 258.33
COMMISSIONER HORACE CAPRON	(DEC. 5, 1867 TO JULY 31, 1871)	$ 696,397.17
COMMISSIONER FREDERICK WATTS	(AUG. 1, 1871 TO JUNE 30, 1877)	$ 1 421 964.46
COMMISSIONER WILLIAM G LE DUC	(JULY 1, 1877 TO JUNE 30, 1881)	$ 891,000.31
COMMISSIONER GEORGE B. LORING	(JULY 1, 1881 TO APR 3, 1885)	$ 1,790 870.98
COMMISSIONER NORMAN J. COLMAN	(APR 4, 1885 TO FEB. 12, 1889)	$3,775,591.22
SECRETARY NORMAN J COLMAN	(FEB. 13, 1889 TO MAR 6, 1889)	
SECRETARY JEREMIAH M RUSK	(MAR. 7, 1889 TO MAR. 6, 1893)	$ 9,938,211.41
SECRETARY J. STERLING MORTON	(MAR 7, 1893 TO MAR. 5, 1897)	$ 13,386 646.40
SECRETARY JAMES WILSON.	(SINCE MAR. 6, 1897.)	$ 107,839 853.68
TOTAL		$ 141,109,256.03

19549—AGR 1909 (To face page 566.)

FINANCES OF THE DEPARTMENT FOR SEVENTY YEARS.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture from the fiscal year 1839 to the fiscal year 1909, inclusive.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Collection of agricultural statistics, etc	Mar. 3, 1839	5	354	9	1839	$1,000.00	$1,000.00	....
	Aug. 26, 1842	5	533	26	1842	1,000.00	1,000.00	....
	Mar. 3, 1843	5	642	1	1844	2,000.00	2,000.00	....
	June 17, 1844	5	687	1	1845	2,000.00	2,000.00	....
	Mar. 3, 1845	5	757	1	1846	3,000.00	3,000.00	....
	Mar. 3, 1847	9	160	1	1847	3,000.00	3,000.00	....
	Aug. 12, 1848	9	285	1	1848	3,500.00	3,500.00	....
Chemical analyses of vegetable substances	.....do.......	9	285	1	1848	1,000.00	1,000.00	....
Collection of agricultural statistics, etc	Mar. 3, 1849	9	364	1	1849	3,500.00	3,500.00	....
Chemical analyses of vegetable substances	.....do.......	9	364	1	1850	1,000.00	1,000.00	....
Collection of agricultural statistics	Sept. 30, 1850	9	541	1	1850	4,500.00	4,500.00	....
	Mar. 3, 1851	9	615	1	1851	5,500.00	5,500.00	....
Collection of agricultural statistics and purchase of seeds	Aug. 31, 1852	10	95	1	1852	5,000.00	5,000.00	....
	Mar. 3, 1853	10	208	1	1853	5,000.00	5,000.00	....
Collection of agricultural statistics and purchase, etc., of seeds	May 31, 1854	10	292	1	1854	10,000.00	10,000.00	....
	Aug. 4, 1854	10	567	1	1865	50,000.00	50,000.00	....
	Mar. 3, 1855	10	664	1				
Collection of agricultural statistics, etc., and purchase, etc., of seeds	May 15, 1856	11	14	1	1856	30,000.00	30,000.00	....
	Aug. 18, 1856	11	89	1	1857	75,000.00	75,000.00	....
	Mar. 3, 1857	11	226	1	1858	60,000.00	60,000.00	....
Information in relation to consumption of cotton	.....do.......	11	226	1	1858	3,500.00	3,157.25	$342.75
Collection of agricultural statistics, etc., and purchase, etc., of seeds	June 12, 1858	11	321	1	1859	60,000.00	60,000.00	....
	Mar. 3, 1859	11	427	1	1860	40,000.00	40,000.00	....
	June 25, 1860	12	108	1	1861	60,000.00	60,000.00	....
	Mar. 2, 1861	12	217	1	1862	64.000.00	63,704.21	295.79
	Feb. 13, 1862	12	338	...				
Collection of agricultural statistics, etc., and purchase, etc., of seeds, including a deficiency appropriation of $20,000, made March 3, 1863	Mar. 1, 1862	12	350	1	1863	80,000.00	80,000.00	....
Salaries	Feb. 25, 1863	12	691	1	1864	5,000.00	5,000.00	....
Collection of agricultural statistics, etc., and purchase, etc., of seeds	.....do.......	12	691	1	1864	87,000.00	87,000.00	....
Culture of cotton and tobacco	.....do.......	12	691	1	1864	3,000.00	3,000.00	....
Investigations with flax and hemp	.....do.......	12	691	1	1864	20,000.00	9,500.00	10,500.00
Purchase of sorghum seed	Mar. 14, 1864	13	23	1	1864	2,000.00	2,000.00	....
To rebuild shop in propagating garden	.....do.......	13	23	1	1864	800.00	800.00	....
Postage	.....do.......	13	23	1	1864	1,320.00	1,320.00	....
Furniture, carpets, fuel, etc	.....do.......	13	23	1	1864	650.00	650.00	....
Salaries	June 25, 1864	13	155	1	1865	38,300.00	38,300.00	....
	July 2, 1864	13	350	2				
Contingent expenses	June 25, 1864	13	155	1	1865	3,500.00	3,500.00	....
Collecting agricultural statistics	.....do.......	13	155	1	1865	20,000.00	20,000.00	....
Furniture, carpets, etc	.....do.......	13	155	1	1865	800.00	800.00	....
Library and laboratory	.....do.......	13	155	1	1865	4,000.00	4,000.00	....
Purchase and distribution of seeds	.....do.......	13	155	1	1865	61,000.00	61,000.00	....
Experimental garden and grounds	.....do.......	13	155	1	1865	15,800.00	15,800.00	....
To pay a debt incurred in preparing the Agricultural Report for 1861	July 2, 1864	13	350	2	1865	3,704.05	3,596.55	107.50
Rent, etc., of Commissioner's office	July 4, 1864	13	381	3	1865	3,500.00	3.500.00	....
Salaries	Mar. 2, 1865	13	160	3	1866	46.726.59	46,726.59	....
		13	455	1				
Contingent expenses	.....do.......	13	455	1	1866	7,500.00	7,500.00	....
Collecting agricultural statistics	.....do.......	13	455	1	1866	20,000.00	20,000.00	....
Purchase, etc., of seeds	.....do.......	13	160	3	1866	70,165.90	70,165.90	....
		13	455	1				
Experimental garden and grounds, etc	.....do.......	13	160	3	1866	23,395.33	23,395.33	....
		13	455	1				
Salaries	July 23, 1866	14	201	1	1867	39,600.00	39,600.00	....
Contingent expenses	.....do.......	14	201	1	1867	11,500.00	11,500.00	....

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Collecting agricultural statistics	July 23, 1866	14	201	1	1867	$10,000.00	$10,000.00	....
Purchase of seeds	do Mar. 30, 1867	14 14 15	201 202 28	1 1 1	1867	115,200.00	115,200.00	....
Experimental garden and grounds, etc	July 23, 1866	14	202	1	1867	22,800.00	22,800.00	....
Salaries	Mar. 2, 1867	14	451	1	1868	38,020.00	38,020.00	....
Contingent expenses	do	14	451	1	1868	13,000.00	13,000.00	....
Collecting agricultural statistics	do	14	451	1	1868	10,000.00	8,406.34	$1,593.66
Purchase, etc., of seeds	do	14	452	1	1868	85,200.00	85,200.00	....
Museum	do	14	452	1	1868	10,000.00	10,000.00	....
Experimental garden and grounds	do	14	452	1	1868	22,800.00	22,800.00	....
To erect a building for the Department of Agriculture	do	14	464	1	1868	100,000.00	99,668.00	332.00
For certain goods and services furnished the Department	July 13, 1868	15	90	1	......	37,604.70	37,604.70	....
Salaries	July 20, 1868	15	105	1	1869	65,368.00	65,368.00	....
Collecting agricultural statistics	do	15	106	1	1869	10,000.00	10,000.00	....
Contingent expenses	do	15	196	1	1869	31,090.00	31,090.00	....
Experimental garden and grounds	do	15	106	1	1869	23,500.00	23,500.00	....
Purchase, etc., of seeds	do	15	106	1	1869	20,000.00	20,000.00	....
Furniture, cases, and repairs	do	15	106	1	1869	22,635.00	22,635.00	....
Salaries	Mar. 3, 1869	15 15	297 298	1 1	1870	69,240.00	67,720.00	1,520.00
Collecting agricultural statistics	do	15	298	1	1870	15,000.00	15,000.00	....
Investigations of cattle disease	do	15	298	1	1870	15,000.00	12,695.60	2,304.40
Contingent expenses	do	15	298	1	1870	13,200.00	13,200.00	....
Furniture, cases, and repairs	do	15	298	1	1870	2,500.00	2,500.00	....
Experimental garden and grounds	do	15	298	1	1870	21,500.00	21,500.00	....
Purchase, etc., of seeds	do	15	298	1	1870	20,000.00	18,981.33	1,018.67
Salaries	July 12, 1870 July 15, 1870	16 16	245 314	1 1	1871	71,980.00	71,811.64	168.36
Collecting agricultural statistics	July 12, 1870	16	245	1	1871	15,000.00	15,000.00	....
Purchase, etc., of seeds	do	16	246	1	1871	30,000.00	28,865.17	1,134.83
Experimental garden and grounds	do July 15, 1870	16 16 16	246 302 303	1 1 1	1871	53,200.00	53,200.00	....
Contingent expenses	July 12, 1870	16	246	1	1871	8,100,00	8,100.00	....
Furniture, cases, and repairs	do	16	246	1	1871	4,700.00	4,700.00	....
Collecting and modeling specimens of fruit	do	16	246	1	1871	1,000.00	1,000.00	....
Library	do	16	246	1	1871	1,000.00	1,000.00	....
Herbarium	do	16	246	1	1871	1,000.00	1,000.00	....
Laboratory	do	16	246	1	1871	1,700.00	1,700.00	....
Folding room	do	16	246	1	1871	500.00	500.00	....
Salaries	Mar. 3, 1871	16	489	1	1872	75,170.00	75,017.89	152.11
Collecting agricultural statistics	do	16	489	1	1872	15,000.00	14,059.36	940.64
Purchase and distribution of seeds, etc	do	16	489	1	1872	45,000.00	45,000.00	....
Experimental garden and grounds	do	16 16	489 509	1 1	1872	36,800.00	36,800.00	....
Contingent expenses	do	16 16	489 490	1 1	1872	12,900.00	12,900.00	....
Furniture, cases, and repairs	do	16	490	1	1872	4,700.00	4,700.00	....
Collecting and modeling specimens of fruit	do	16	490	1	1872	1,000.00	1,000.00	....
Herbarium	do	16	490	1	1872	1,000.00	1,000.00	....
Library	do	16	490	1	1872	2,050.00	2,050.00	....
Laboratory	do	16	490	1	1872	3,450.00	3,450.00	....
Salaries	May 8, 1872	17	77	1	1873	75,890.00	75,889.73	.27
Collecting agricultural statistics	do	17	77	1	1873	15,000.00	15,000.00	....
Purchase and distribution of seeds	do	17	77	1	1873	55,000.00	55,000.00	....

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Experimental garden and grounds	May 8, 1872 June 10, 1872	17 17	77 368	1 1	1873	$31,000.00	$31,000.00	....
Contingent expenses	May 8, 1872	17 17	77 78	1 1	1873	13,300.00	12,507.06	$792.94
Folding room	do	17	77	1	1873	300.00	300.00	....
Furniture, cases, and repairs	do	17	78	1	1873	5,200.00	5,200.00	....
Museum and herbarium	do June 10, 1872	17 17	78 369	1 1	1873	5,000.00	4,674.43	325.57
Library	May 8, 1872	17	78	...	1873	1,750.00	1,750.00	....
Salaries	Mar. 3, 1873	17	506	1	1874	78,190.00	76,924.00	1,266.00
Collecting agricultural statistics	do	17	506	1	1874	15,000.00	11,553.20	3,446.80
Purchase and distribution of seeds, etc	do	17 17 17	506 507 540	1 1 1	1874	65,000.00	64,904.89	95.11
Experimental garden and grounds	do	17 17	507 529	1 1	1874	26,200.00	25,731.74	468.26
Museum and herbarium	do	17	507	1	1874	2,000.00	1,942.02	57.98
Contingent expenses	do	17	507	1	1874	13,600.00	12,699.34	900.66
Furniture, cases, and repairs	do	17	507	1	1874	4,200.00	3,302.40	897.60
Library	do	17	507	1	1874	1,500.00	1,259.10	240.90
Postage	do	17	542	4	1874	52,000.00	35,449.09	16,550.91
Salaries	June 20, 1874	18	107	1	1875	77,180.00	77,127.60	52.40
Collecting agricultural statistics	do	18	107	1	1875	15,000.00	12,147.56	2,852.44
Purchase and distribution of seeds, etc	do Jan. 25, 1875	18 18	107 303	1 3	1875	95,000.00	94,719.83	280.17
Furniture, cases, and repairs	June 20, 1874	18	107	1	1875	4,200.00	4,135.36	64.64
Experimental garden and grounds	do June 23, 1874	18 18	107 227	1 1	1875	24,100.00	24,094.06	5.94
Contingent expenses	June 20, 1874	18	107	1	1875	12,600.00	10,972.61	1,627.39
Museum and herbarium	do June 23, 1874	18 18	107 227	1 1	1875	4,500.00	3,300.00	1,020.00
Laboratory	do	18	227	1	1875	1,300.00	1,300.00	....
Library	do	18	227	1	1875	1,500.00	1,087.90	412.10
Postage	June 20, 1874	18	107	1	1875	52,000.00	42,633.00	9,367.00
To publish Commissioner's report for the years 1872 and 1873	June 23, 1874	18	227	1	1875	50,000.00	49,561.91	438.09
Salaries	Mar. 3, 1875	18	368	1	1876	77,180.00	77,115.71	64.29
Collecting agricultural statistics	do	18	368	1	1876	15,000.00	14,500.00	500.00
Purchase and distribution of seeds	do	18	368	1	1876	65,000.00	65,000.00	....
Experimental garden and grounds	do	18 18	368 394	1 1	1876	19,990.00	19,956.11	33.89
Museum and herbarium	do	18	368	1	1876	2,000.00	1,993.55	6.45
Furniture, cases, and repairs	do	18	368	1	1876	3,300.00	3,124.23	175.77
Library	do	18	368	1	1876	1,250.00	1,046.84	203.16
Laboratory	do	18	368	1	1876	1,300.00	1,300.00	....
Contingent expenses	do	18	368	1	1876	12,100.00	11,378.91	721.09
Postage	do	18	368	1	1876	52,000.00	3,428.29	48,571.71
Salaries	July 21, 1876 Aug. 15, 1876	19 19	95 167	1 1	1877	67,836.96	67,806.19	30.77
Experimental garden and grounds	July 31, 1876 Aug. 15, 1876	19 19	115 167	1 1	1877	11,550.00	11,550.00	....
Collecting agricultural statistics	do	19	167	1	1877	10,000.00	10,000.00	....
Purchase and distribution of seeds, etc	do Mar. 3, 1877	19 19	167 319	1 1	1877	85,000.00	80,000.00	5,000.00
Museum and herbarium	Aug. 15, 1876	19	167	1	1877	2,000.00	2,000.00	....
Furniture, cases, and repairs	do	19	167	1	1877	2,000.00	2,000.00	....
Library	do	19	167	1	1877	1,000.00	800.00	200.00
Laboratory	do	19	167	1	1877	1,300.00	1,300.00	....
Contingent expenses	do	19	167	1	1877	10,000.00	8,800.00	1,200.00
Postage	do	19	167	1	1877	4,000.00	3,950.00	50.00
Salaries	Mar. 3, 1877	19	317	1	1878	65,640.00	65,640.00	....
Collecting agricultural statistics	do	19	317	1	1878	15,000.00	15,000.00	....
Purchase and distribution of seeds, etc	do	19	317	1	1878	75,000.00	74,579.33	420.67
Experimental garden and grounds	do	19 19	317 360	1 1	1878	10,500.00	10,500.00	....

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Museum	Mar. 3, 1877	19	317	1	1878	$1,500.00	$1,500.00	....
Furniture, cases, and repairs	....do....	19	317	1	1878	4,500.00	4,500.00	....
Library	....do....	19	317	1	1878	1,000.00	1,000.00	....
Laboratory	....do....	19	317	1	1878	1,000.00	1,000.00	....
Contingent expenses	....do....	19	317	1	1878	8,000.00	8,000.00	....
Postage	....do....	19	317	1	1878	4,000.00	3,415.61	$584.39
Report on forestry	....do....	19	360	1	1878	2,500.00	2,500.00	....
International Industrial Exposition at Paris	Dec. 15, 1877	20	246	4	1878	10,000.00	10,000.00	....
Salaries	June 19, 1878	20	203	1	1879	66,900.00	66,900.00	....
Collecting agricultural statistics	....do....	20	203	1	1879	10,000.00	10,000.00	....
Purchase and distribution of seeds, etc	....do....	20	203	1	1879	75,000.00	75,000.00	....
Experimental garden and grounds	....do....	20 20	203 240	1 1	1879	13,500.00	13,500.00	....
Museum	....do....	20	203	1	1879	1,000.00	1,000.00	....
Furniture, cases, and repairs	....do....	20	204	1	1879	4,000.00	4,000.00	....
Library	....do....	20	204	1	1879	1,000.00	1,000.00	....
Laboratory	....do....	20	204	1	1879	1,500.00	1,500.00	....
Contingent expenses	....do....	20	204	1	1879	8,000.00	8,000.00	....
Postage	....do....	20	204	1	1879	4,000.00	3,960.00	40.00
Investigating the history and habits of insects	....do....	20	204	1	1879	10,000.00	10,000.00	....
Investigating diseases of domestic animals	....do....	20	240	1	1879	10,000.00	10,000.00	....
To erect a stable	Mar. 3, 1879	20	392	1	1879	1,500.00	1,500.00	....
Salaries	June 21, 1879	21	23	1	1880	66,900.00	66,900.00	....
Collecting agricultural statistics	....do....	21	23	1	1880	10,000.00	9,982.88	17.12
Purchase and distribution of seeds, etc	....do....	21	23	1	1880	75,000.00	75,000.00	....
Experimental garden and grounds	....do....	21	23	1	1880	13,100.00	13,100.00	....
Museum	....do....	21	23	1	1880	1,000.00	1,000.00	....
Furniture, cases, and repairs	....do....	21	23	1	1880	4,000.00	4,000.00	....
Library	....do....	21	23	1	1880	1,000.00	1,000.00	....
Laboratory	....do....	21	23	1	1880	1,500.00	1,500.00	....
Contingent expenses	....do....	21	23	1	1880	8,000.00	8,000.00	....
Postage	....do....	21	23	1	1880	4,000.00	4,000.00	....
Investigating the history and habits of insects	....do....	21	29	1	1880	5,000.00	5,000.00	....
Investigating diseases of domestic animals	....do....	21	30	1	1880	10,000.00	8,878.84	1,121.16
Salaries	June 16, 1880	21	292	1	1881	69,200.00	69,185.22	14.78
Purchase and distribution of seeds, etc	....do.... May 3, 1881	21 21	294 453	1 1	1881	102,160.31	102,157.48	2.83
Collecting agricultural statistics	June 16, 1880	21	293	1	1881	10,000.00	9,985.60	14.40
Experimental garden and grounds	....do....	21	294	1	1881	12,600.00	12,600.00	....
Museum	....do....	21	294	1	1881	1,000.00	1,000.00	....
Furniture, cases, and repairs	....do....	21	294	1	1881	5,000.00	5,000.00	....
Library	....do....	21	294	1	1881	1,000.00	1,000.00	....
Laboratory	....do....	21	295	1	1881	4,000.00	4,000.00	....
Contingent expenses	....do....	21	295	1	1881	10,000.00	9,769.17	230.83
Postage	....do....	21	295	1	1881	4,000.00	3,838.00	162.00
Report on forestry	....do....	21	296	1	1881	5,000.00	3,762.51	1,237.49
Investigating the history and habits of insects	....do....	21	294	1	1881	5,000.00	4,997.31	2.69
Investigating the diseases of domestic animals	....do....	21	295	1	1881	10,000.00	10,000.00	....
Examination of fibers	....do....	21	295	1	1881	4,000.00	4,000.00	....
Experiments in the manufacture of sugar	....do....	21	295	1	1881	7,500.00	7,500.00	....
Collecting data touching arid regions of the United States	....do....	21	295	1	1881	5,000.00	460.00	4,540.00
Reclamation of arid lands	....do....	21	295	1	1881	20,000.00	18,353.55	(a)
Salaries	Mar. 3, 1881	21	381	1	1882	79,500.00	79,491.81	8.19
Collecting agricultural statistics	....do....	21	382	1	1882	10,000.00	10,000.00	....
Laboratory	....do....	21	382	1	1882	6,000.00	5,811.85	188.15

[a] Unexpended balance of $1,646.45 carried to fiscal year 1882.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Purchase and distribution of seeds, etc	Mar. 3, 1881 Apr. 16, 1882	21 22	382 44	1 1	1882	$100,000.00	$99,991.53	$8.47
Experiments in the culture, etc., of tea	Mar. 3, 1881	21	383	1	1882	10,000.00	8,750.87	1,249.13
Experimental garden and grounds	do	21 21	383 385	1 1	1882	15,000.00	14,968.25	31.75
Museum	do	21	383	1	1882	1,000.00	1,000.00	....
Furniture, cases, and repairs	do	21	383	1	1882	4,000.00	4,000.00	....
Library	do	21	383	1	1882	1,000.00	973.85	26.15
Investigating the history and habits of insects	do	21	383	1	1882	20,000.00	19,998.94	1.06
Examination of fibers	do	21	384	1	1882	5,000.00	5,000.00	....
Investigating the diseases of domestic animals	do	21	384	1	1882	25,000.00	22,443.89	2,556.11
Collecting data touching the arid regions of the United States	do	21	384	1	1882	5,000.00	4,216.55	783.45
Reclamation of arid lands, including an unexpended balance of $1,646.45 from fiscal year 1881	do	21	384	1	1882	11,646.45	11,561.19	(*a*)
Report on forestry	do	21	384	1	1882	5,000.00	4,941.00	59.00
Postage	do	21	384	1	1882	4.000.00	4,000.00	....
Contingent expenses	do	21	384	1	1882	10,000.00	10,000.00	....
Building for display of agricultural implements	do	21	385	1	1882	10,000.00	10,000.00	....
Experiments in the manufacture of sugar (including $864.60 from sale of molasses, etc.)	do	21	384	1	1882	35,864.60	32,333.75	(*b*)
Transportation of specimens from Atlanta	Feb. 13, 1882	22	3	1	1882	5,000.00	4,998.91	1.09
Salaries	May, 19, 1882	22	89	1	1883	102,580.00	102,575.49	4.51
Collecting agricultural statistics	do	22	90	1	1883	80,000.00	78.170.80	1,829.20
Laboratory	do	22	90	1	1883	6,000.00	6,000.00	....
Purchase and distribution of seeds, etc	do	22	90	1	1883	80,000.00	80,000.00	....
Experiments in the culture, etc., of tea	do	22	91	1	1883	5,000.00	3,905.66	1,094.34
Experimental garden and grounds	do	22 22	91 92	1 1	1883	15,500.00	15,471.82	28.18
Museum	do	22	91	1	1883	1,000.00	1,000.00	....
Furniture, cases, and repairs	do	22	91	1	1883	6,700.00	6,700.00	....
Library	do	22	91	1	1883	1,500.00	1,485.32	14.68
Investigating the history and habits of insects	do	22	91	1	1883	20,000.00	19,997.75	2.25
Examination of fibers	do	22	91	1	1883	10,000.00	7,961.94	2,038.06
Investigating the diseases of domestic animals	do	22	92	1	1883	25,000.00	21,584.28	3,415.72
Reclamation of arid lands, including an unexpended balance of $85.26 from fiscal year 1882	do	22	92	1	1883	20,085.26	12,429.13	(*c*)
Report on forestry	do	22	92	1	1883	10,000.00	8,731.99	1,268.01
Postage	do	22	92	1	1883	4,000.00	3,977.49	22.51
Contingent expenses	do	22	92	1	1883	15,000.00	14,920.74	79.26
Experiments in the manufacture of sugar, including an unexpended balance of $3,530.85 from fiscal year 1882	do	22	92	1	1883	28,530.85	28,529.31	1.54
Erection of building for seed division	Aug. 7, 1882	22	306	1	1883	25,000.00	25.000.00	....
Report on the Angora goat	do	22	337	1	1883	500.00	500.00	....
Salaries	Jan. 20, 1883	22	408	1	1884	127,640.00	127,639.87	.13
Collecting agricultural statistics	do	22	410	1	1884	80,000.00	79.770.86	229.14
Laboratory, and for experiments in the manufacture of sugar, including $842.18 from the sale of sirup, etc	do	22	410	1	1884	16,842.18	16,829.26	12.92

a Unexpended balance of $85.26 carried to fiscal year 1883.
b Unexpended balance of $3,530.85 carried to fiscal year 1883.
c Unexpended balance of $7,656.13 carried to fiscal year 1884.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Purchase and distribution of seeds, etc	Jan. 20, 1883	22	410	1	1884	$75,000.00	$74,986.48	$13.52
Experimental gardens and grounds	....do	22 22	409 411	1 1	1884	15,500.00	15,448.87	51.13
Museum	....do	22	409	1	1884	1,000.00	993.51	6.49
Furniture, cases, and repairs	....do	22	410	1	1884	6,000.00	5,998.82	1.18
Library	....do	22	411	1	1884	1,500.00	1,439.86	60.14
Investigating the history and habits of insects	....do Aug. 4, 1886	22 24	409 273	1 1	1884	20,002.82	20,002.82	....
Reclamation of arid lands, including an unexpended balance of $7,656.13 from fiscal year 1883	Jan. 20, 1883	22	411	1	1884	17,656.13	16,164.68	1,491.45
Investigating the diseases of domestic animals	....do	22	411	1	1884	25,000.00	24,011.85	988.15
Report on forestry	....do	22	411	1	1884	10,000.00	9,998.30	1.70
Postage	....do	22	411	1	1884	4,000.00	3,841.48	158.52
Contingent expenses	....do	22	411	1	1884	14,000.00	13,991.43	8.57
Building of greenhouse	....do	22	631	1	1884	2,500.00	2,500.00	....
Salaries	June 5, 1884	23	36	1	1885	137,590.00	137,557.80	32.20
Collecting agricultural statistics	....do	23	38	1	1885	100,000.00	99,986.59	13.41
Bureau of Animal Industry	May 29, 1884	23	31	1	1885	150,000.00	56,807.73	(*a*)
Purchase and distribution of seeds, etc	June 5, 1884	23	38	1	1885	100,000.00	99,983.82	16.18
Laboratory, and for experiments in the manufacture of sugar	....do	23	38	1	1885	50,000.00	49,996.70	3.30
Investigating the history and habits of insects	....do	23	37	1	1885	20,000.00	19,986.83	13.17
Silk culture	....do	23	39	1	1885	15,000.00	14,916.23	83.77
Contingent expenses	....do	23	39	1	1885	15,000.00	14,862.20	137.80
Report on forestry	....do	23	39	1	1885	10,000.00	9,987.36	12.64
Experimental garden and grounds	....do Oct. 19, 1888	23 25	37 581	1 1	1885	17,840.25	17,513.67	326.58
Furniture, cases, and repairs	June 5, 1884	23	38	1	1885	6,000.00	5,947.27	52.73
Postage	....do	23	39	1	1885	4,000.00	3,956.98	43.02
Experiments in the culture, etc., of tea	....do	23	39	1	1885	3,000.00	2,998.90	1.10
Library	....do	23	39	1	1885	1,500.00	1,403.63	96.37
Museum	....do	23	37	1	1885	1,000.00	1,000.00	....
Quarantine stations	June 7, 1884	23	207	1	1885	25,000.00	22,029.18	(*b*)
Salaries	Mar. 3, 1885	23	353	1	1886	137,590.00	137,337.42	252.58
Collecting agricultural statistics	....do	23	355	1	1886	75,000.00	68,723.06	6,276.94
Bureau of Animal Industry, including an unexpended balance of $93,192.27 from fiscal year 1885	....do	23	355	1	1886	193,192.27	58,261.05	134,931.22
Quarantine stations, including an unexpended balance of $2,970.82 for fiscal year 1885	....do	23	356	1	1886	32,970.82	18,958.57	14,012.25
Purchase and distribution of seeds, etc	....do	23	354	1	1886	100,000.00	99,980.24	19.76
Laboratory, and for experiments in the manufacture of sugar	....do	23	354	1	1886	40,000.00	39,942.11	57.89
Investigating the history and habits of insects	....do	23	354	1	1886	25,000.00	24,976.46	23.54
Silk culture	....do Oct. 19, 1888	23 25	356 581	1 1	1886	15,012.00	15,008.50	3.50
Contingent expenses	Mar. 3, 1885	23	356	1	1886	15,000.00	14,937.62	62.38
Report on forestry	....do	23	356	1	1886	10,000.00	9,836.83	163.17
Experimental garden and grounds	....do Aug. 4, 1886 Oct. 19, 1888	23 24 25	254 273 581	1 1 1	1886	17,208.13	17,024.88	183.25
Furniture, cases, and repairs	Mar. 3, 1885	23	354	1	1886	7,500.00	7,423.59	76.41
Postage	....do	23	356	1	1886	4,000.00	2,556.20	1,443.80
Experiments in the culture, etc., of tea	....do	23	356	1	1886	3,000.00	1,813.67	1,186.33
Library	....do	23	355	1	1886	1,500.00	1,417.03	82.97
Museum	....do	23	354	1	1886	1,000.00	998.88	1.12
Salaries	June 30, 1886	24	100	1	1887	142,890.00	141,420.68	1,469.32

[a] Unexpended balance of $93,192.27 carried to fiscal year 1886.

[b] Unexpended balance of $2,970.82 carried to fiscal year 1886.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Collecting agricultural statistics	June 30, 1886	24	103	1	1887	$65,000.00	$64,955.14	$44.86
Bureau of Animal Industry	do	24	103	1	1887	100,000.00	99,985.56	14.44
Quarantine stations	do	24	103	1	1887	30,000.00	10,639.44	19,360.56
Purchase and distribution of seeds, etc	do	24	102	1	1887	100,000.00	99,998.37	1.63
Laboratory	do	24	101	1	1887	6,000.00	4,570.86	1,429.14
Experiments in the manufacture of sugar, including $1,891 from sales	do	24	101	1	1887	95,891.00	95,853.14	37.86
Investigating the history and habits of insects	do Oct. 19, 1888	24 25	101 582	1 1	1887	15,096.25	15,088.05	8.20
Silk culture, including $864.81 from sale of raw silk	June 30, 1886 Oct. 19, 1888	24 25	101 581	1 1	1887	15,939.56	15,939.56	....
Contingent expenses	June 30, 1886	24	104	1	1887	15,000.00	14,936.83	63.17
Report on forestry	do	24	103	1	1887	8,000.00	7,953.50	46.50
Experimental garden and grounds	do	24	102	1	1887	23,200.00	22,202.15	997.85
Furniture, cases, and repairs	do	24	103	1	1887	8,125.00	8,092.11	32.89
Postage	do	24	104	1	1887	4,000.00	3,500.00	500.00
Experiments in the culture, etc., of tea	do	24	104	1	1887	2,000.00	1,753.78	246.22
Pomological information	do	24	100	1	1887	3,000.00	2,993.20	6.80
Library	do	24	103	1	1887	1,500.00	1,428.65	71.35
Botanical investigations	do	24	100	1	1887	5,000.00	4,988.12	11.88
Museum	do	24	102	1	1887	1,000.00	998.88	1.12
Ornithology and mammalogy	do	24	101	1	1887	10,000.00	9,999.98	.02
Reclamation of arid lands	do	24	103	1	1887	5,000.00	....	5,000.00
Adulteration of food	do	24	100	1	1887	1,000.00	989.14	10.86
Salaries	Mar. 3, 1887	24	495	1	1888	161,490.00	158,220.87	3,269.13
Collecting agricultural statistics	do	24	498	1	1888	65,000.00	64,965.33	34.67
Bureau of Animal Industry, including $100,000 immediately available	do	24	499	1	1888	500,000.00	499,975.32	24.68
Quarantine stations	do	24	499	1	1888	20,000.00	9,538.75	10,461.25
Purchase and distribution of seeds, etc	do	24	498	1	1888	103,000.00	102,587.55	412.45
Laboratory	do	24	497	1	1888	6,000.00	5,969.89	30.11
Experiments in the manufacture of sugar	do	24	497	1	1888	50,000.00	49,997.43	2.57
Experiments in the manufacture of sugar (deficiency)	Oct. 19, 1888	25	582	1	1887 1888	8,000.00	7,927.50	72.50
Investigating the history and habits of insects	Mar. 3, 1887	24	497	1	1888	20,000.00	20,000.00	....
Silk culture, including $1,989.06 from sale of raw silk	do	24	497	1	1888	16,989.06	16,989.02	.04
Contingent expenses	do	24	499	1	1888	15,000.00	14,825.57	174.43
Report on forestry	do	24	499	1	1888	8,000.00	7,996.10	3.90
Experimental garden and grounds	do	24	497	1	1888	24,800.00	24,706.86	93.14
Furniture, cases, and repairs	do	24	498	1	1888	7,000.00	6,982.88	17.12
Postage	do	24	499	1	1888	4,000.00	3,000.00	1,000.00
Pomological information	do	24	497	1	1888	3,000.00	2,971.69	28.31
Library	do	24	499	1	1888	2,000.00	1,983.78	16.22
Botanical investigations	do	24	496	1	1888	7,000.00	6,997.28	2.72
Museum	do	24	497	1	1888	1,000.00	947.41	52.59
Ornithology and mammalogy	do	24	497	1	1888	3,940.00	3,869.23	70.77
Adulteration of food	do	24	497	1	1888	1,000.00	830.16	169.84
Salaries	July 18, 1888 Mar. 2, 1889	25 25	328 923	1 1	1889	171,890.32	169,152.51	2,737.81
Collecting agricultural statistics	July 18, 1888	25	332	1	1889	70,000.00	69,162.45	837.55
Botanical investigations	do	25	330	1	1889	35,000.00	22,076.75	(a)
Investigating the history and habits of insects	do Sept. 30, 1890	25 26	331 525	1 1	1889	20,131.64	20,131.64	....
Ornithology and mammalogy	July 18, 1888 Mar. 2, 1889 Sept. 30, 1890 Mar. 3, 1891	25 25 26 26	332 838 525 880	1 1 1 1	1889	5,025.90	5,022.06	3.84
Pomological information	July 18, 1888	25 26	330 526	1 1	1889	4,024.48	4,020.32	4.16
Microscopical investigations	do	25	330	1	1889	1,000.00	999.87	.13
Laboratory	do Mar. 2, 1889	25 25	330 837	1 1	1889	11,000.00	9,994.25	1,005.75

[a] Unexpended balance of $12,923.25 carried to fiscal year 1890.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Forestry investigations	July 18, 1888	25	333	1	1889	$8,000.00	$7,999.03	$0.97
Purchase and distribution of seeds	do	25	332	1	1889	104,200.00	104,168.73	31.27
Experimental gardens and grounds	do	25	332	1	1889	26,640.00	26,639.83	.17
Museum	do	25	332	1	1889	1,000.00	891.25	108.75
Furniture, cases, and repairs	do	25	333	1	1889	7,350.00	7,236.74	113.26
Library	do	25	333	1	1889	2,000.00	1,956.34	43.66
Postage	do	25	333	1	1889	4,000.00	4,000.00	....
Contingent expenses	do Mar. 3, 1891	25 26	333 881	1 1	1889	15,010.00	15,009.22	.78
Office of Experiment Stations	July 18, 1888	25	334	1	1889	10,000.00	9,033.77	966.23
Experiments in the manufacture of sugar	do	25	333	1	1889	100,000.00	41,635.24	(a)
Quarantine stations	do	25	333	1	1889	15,000.00	11,628.39	3,371.61
Bureau of Animal Industry	do	25	333	1	1889	500,000.00	479,623.57	20,376.43
Silk culture, including $708.26 from sale of raw silk	do	25	331	1	1889	23,208.26	23,208.26	....
Salaries	Mar. 2, 1889	25	835	1	1890	178,580.00	175,547.04	3,032.96
Collecting agricultural statistics	do	25	839	1	1890	75,000.00	74,327.51	672.49
Botanical investigations, including an unexpended balance of $12,923.25 from fiscal year 1889	do July 28, 1892	25 27	836 296	1 1	1890	48,009.25	47,990.38	18.87
Investigating the history and habits of insects	Mar. 2, 1889	25	837	1	1890	20,000.00	19,892.72	107.28
Ornithology and mammalogy	do July 14, 1890	25 26	838 285	1 1	1890	7,000.00	6,994.16	5.84
Pomological information	Mar. 2, 1889 Mar. 3, 1891	25 26	837 881	1 1	1890	4,304.79	4,304.79	....
Microscopical investigations	Mar. 2, 1889 July 28, 1892	25 27	837 296	1 1	1890	1,062.50	1,062.50	....
Laboratory	Mar. 2, 1889	25	837	1	1890	6,000.00	5,461.99	538.01
Forestry investigations	do	25	840	1	1890	8,000.00	7,999.96	.04
Purchase and distribution of seeds	do	25	839	1	1890	104,200.00	104,174.55	25.45
Experimental garden and grounds	do	25	838	1	1890	26,640.00	26,478.45	161.55
Museum	do	25	838	1	1890	1,000.00	998.39	1.61
Furniture, cases, and repairs	do Apr. 4, 1890	25 26	839 42	1 1	1890	9,350.00	9,261.93	88.07
Library	Mar. 2, 1889	25	839	1	1890	2,000.00	1,738.28	261.72
Postage	do	25	840	1	1890	4,000.00	4,000.00	....
Contingent expenses	do Apr. 4, 1890	25 26	840 42	1 1	1890	20,000.00	19,965.32	34.68
Office of Experiment Stations	Mar. 2, 1889	25	840	1	1890	15,000.00	14,991.69	8.31
Experiments in the manufacture of sugar, including an unexpended balance of $58,364.76 from fiscal year 1889	do	25	840	1	1890	83,364.76	83,064.14	300.62
Quarantine stations	do	25	840	1	1890	15,000.00	11,266.24	3,733.76
Bureau of Animal Industry	do	25	839	1	1890	500,000.00	311,025.31	(b)
Silk culture, including $1,627.81 from sale of raw silk	do	25	837	1	1890	21,627.81	21,626.10	1.71
Artesian wells	Apr. 4, 1890	26	42	1	1890	20,000.00	19,652.17	347.83
Salaries	July 14, 1890	26	282	1	1891	248,902.85	239,923.29	8,979.56
Collecting agricultural statistics	do	26	284	1	1891	100,000.00	85,126.44	14,873.56
Botanical investigations	do	26	284	1	1891	40,000.00	36,428.36	3,571.64
Investigating the history and habits of insects	do July 28, 1892	26 27	285 296	1 1	1891	27,501.77	27,481.00	20.77
Ornithology and mammalogy	July 14, 1890 July 28, 1892	26 27	285 296	1 1	1891	14,004.90	13,003.67	1,001.23
Pomological information	July 14, 1890	26	285	1	1891	5,000.00	4,983.88	16.12
Microscopical investigations	do	26	285	1	1891	5,000.00	3,281.90	1,718.10
Vegetable pathology	do	26	285	1	1891	15,000.00	14,995.75	4.25
Laboratory	do	26	286	1	1891	20,200.00	19,985.27	214.73
Forestry investigations	do	26	286	1	1891	10,000.00	9,785.99	214.01
Illustrations and engravings	do	26	286	1	1891	2,000.00	1,999.58	.42
Purchase and distribution of seeds	do	26	286	1	1891	105,400.00	105,090.94	309.06

[a] Unexpended balance of $58,364.76 carried to fiscal year 1890.

[b] Unexpended balance of $188,974.69 carried to fiscal year 1891.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Document and folding room	July 14, 1890	26	287	1	1891	$2,000.00	$1,995.53	$4.47
Experimental garden and grounds	do	26	287	1	1891	28,500.00	28,396.41	103.59
Museum	do	26	287	1	1891	4,000.00	3,832.28	167.72
Furniture, cases, and repairs	do Mar. 3, 1891	26 26	287 1049	1 1	1891	12,000.00	11,991.01	8.99
Library	July 14, 1890	26	287	1	1891	3,000.00	2,997.20	2.80
Postage	do	26	287	1	1891	5,000.00	4,833.00	167.00
Contingent expenses	do	26	287	1	1891	20,000.00	18,097.13	1,902.87
Office of Experiment Stations	do	26	288	1	1891	15,000.00	14,984.48	15.52
Experiments in the manufacture of sugar	do Mar. 3, 1891	26 26	288 1050	1 1	1891	75,000.00	74,901.18	98.82
Irrigation investigations	Sept. 30, 1890	26	525	1	1891	40,000.00	39,926.67	73.33
Quarantine stations	July 14, 1890	26	288	1	1891	15,000.00	13,586.72	1,413.28
Bureau of Animal Industry, including an unexpended balance of $188,974.69 from fiscal year 1890	do	26	287	1	1891	538,974.69	469,113.35	69,861.34
Silk culture, including $565 from sale of raw silk	do	26	285	1	1891	20,565.00	19,536.33	1,028.67
Salaries	Mar. 3, 1891	26	1045	1	1892	256,800.00	252,766.17	4,033.83
Collecting agricultural statistics	do	26	1046	1	1892	102,500.00	88,869.51	13,630.49
Botanical investigations	do Aug. 23, 1894	26 28	1046 440	1 1	1892	40,246.40	40,246.40	....
Investigating the history and habits of insects	Mar. 3, 1891	26	1047	1	1892	27,800.00	27,780.03	19.97
Ornithology and mammalogy	do	26	1047	1	1892	15,000.00	14,688.00	312.00
Pomological information	do	26	1047	1	1892	5,000.00	4,985.27	14.73
Microscopical investigations	do	26	1047	1	1892	2,000.00	1,251.46	748.54
Vegetable pathology	do Aug. 23, 1894	26 28	1047 440	1 1	1892	15,076.47	15,076.47	....
Laboratory	Mar. 3, 1891	26	1047	1	1892	19,400.00	19,272.59	127.41
Fiber investigations	do	26	1048	1	1892	10,000.00	8,017.44	1,982.56
Forestry investigations	do Mar. 3, 1893	26 27	1048 660	1 1	1892	15,056.85	15,056.85	....
Illustrations and engravings	Mar. 3, 1891	26	1048	1	1892	2,000.00	1,999.85	.15
Purchase and distribution of seeds	do	26	1048	1	1892	105,400.00	104,920.35	479.65
Document and folding room	do	26	1049	1	1892	2,000.00	1,996.82	3.18
Experimental garden and grounds	do Mar. 3, 1893	26 27	1049 660	1 1	1892	28,622.53	28,536.67	85.86
Museum	Mar. 3, 1891	26	1049	1	1892	4,000.00	3,909.17	90.83
Furniture, cases, and repairs	do	26	1049	1	1892	10,000.00	9,996.55	3.45
Library	do	26	1049	1	1892	3,000.00	2,807.75	192.25
Postage	do	26	1049	1	1892	5,000.00	4,900.00	100.00
Contingent expenses	do	26	1049	1	1892	25,000.00	24,762.32	237.68
Office of Experiment Stations	do	26	1050	1	1892	20,000.00	19,989.47	10.53
Experiments in the manufacture of sugar	do Mar. 18, 1892	26 27	1050 7	1 1	1892	35,000.00	34,627.78	372.22
Quarantine stations	Mar. 3, 1891	26	1050	1	1892	15,000.00	14,983.63	16.37
Bureau of Animal Industry	do Mar. 18, 1892	26 27	1045 7	1 1	1892	650,000.00	649,980.91	19.09
Weather Bureau	Mar. 3, 1891	26	1051	1	1892	889,753.50	861,840.83	27,912.67
Salaries	July 5, 1892	27	74	1	1893	256,800.00	253,896.30	2,903.70
Collecting agricultural statistics	do	27	76	1	1893	110,000.00	95,649.21	14,350.79
Botanical investigations and experiments	do	27	76	1	1893	27,500.00	27,451.55	48.45
Investigating the history and habits of insects	do	27	77	1	1893	17,800.00	17,290.80	509.20
Investigations in ornithology and mammalogy	do	27	77	1	1893	15,000.00	14.947.77	52.23
Pomological information	do	27	77	1	1893	5.000.00	4,745.94	254.06
Microscopical investigations	do	27	77	1	1893	2.000.00	1,982.98	17.02
Vegetable pathology	do	27	77	1	1893	20.000.00	19,977.38	22.62
Laboratory	do	27	77	1	1893	19.400.00	18,002.59	1,397.41
Fiber investigations	do	27	78	1	1893	5,000.00	4,997.07	2.93
Forest investigations	do	27	78	1	1893	12,000.00	11.933.39	66.61
Illustrations and engravings	do	27	78	1	1893	2,000.00	1,906.73	93.27
Purchase and distribution of seeds	do	27	78	1	1893	135,400.00	134,908.27	491.73
Document and folding room	do	27	78	1	1893	2,000.00	1,623.55	376.45
Experimental garden and grounds	do	27	78	1	1893	28,500.00	28,115.09	384.91

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Museum	July 5, 1892	27	79	1	1893	$4,000.00	$3,973.67	$26.33
Furniture, cases, and repairs	do	27	79	1	1893	10,000.00	8,931.97	1,068.03
Library	do	27	79	1	1893	3,000.00	2,535.29	464.71
Postage	do	27	79	1	1893	5,000.00	3,705.00	1,295.00
Contingent expenses	do	27	79	1	1893	25,000.00	22,218.19	2,781.81
Experiment stations	do	27	80	1	1893	20,000.00	18,987.65	1,012.35
Experiments in the manufacture of sugar	do	27	80	1	1893	20,000.00	19,984.86	15.14
Irrigation investigations	do	27	76	1	1893	6,000.00	4,930.67	1,069.33
Quarantine stations	do	27	80	1	1893	15,000.00	12,633.23	2,366.77
Experiments in the production of rainfall	do	27	76	1	1893	10,000.00	4,979.59	5,020.41
Bureau of Animal Industry	do	27	79	1	1893	850,000.00	724,696.74	125,303.26
Weather Bureau	do	27	81	1	1893	913,660.72	890,424.77	23,235.95
Salaries	Mar. 3, 1893	27	734	1	1894	256,800.00	233,679.75	23,120.25
Collecting agricultural statistics	do	27	736 737	1	1894	110,000.00	91,080.20	18,919.80
Botanical investigations and experiments	do	27	737	1	1894	30,000.00	24,401.40	5,598.60
Investigating the history and habits of insects	do	27	737	1	1894	20,300.00	16,203.96	4,096.04
Investigations in ornithology and mammalogy	do	27	737	1	1894	17,500.00	17,450.00	50.00
Pomological information	do	27	738	1	1894	5,000.00	4,248.99	751.01
Microscopical investigations	do	27	738	1	1894	2,000.00	1,117.55	882.45
Vegetable pathology	do	27	738	1	1894	20,000.00	17,576.95	2,423.05
Laboratory	do	27	738	1	1894	21,900.00	10,426.79	11,473.21
Fiber investigations	do	27	738	1	1894	5,000.00	2,500.47	2,499.53
Forestry investigations	do	27	738	1	1894	20,000.00	19,995.96	4.04
Illustrations and engravings	do	27	738	1	1894	2,000.00	664.79	1,335.21
Purchase and distribution of seeds	do	27	738	1	1894	135,400.00	119,719.76	15,680.24
Document and folding room	do	27	739	1	1894	2,000.00	1,662.81	337.19
Experimental garden and grounds	do	27	739	1	1894	31,500.00	26,616.86	4,883.14
Museum	do	27	739	1	1894	4,000.00	2,787.22	1,212.78
Furniture, cases, and repairs	do	27	739	1	1894	10,000.00	8,628.76	1,371.24
Library	do	27	739	1	1894	3,000.00	2,900.07	99.93
Postage	do	27	740	1	1894	5,000.00	1,375.00	3,625.00
Contingent expenses	do	27	740	1	1894	25,000.00	20,493.04	4,506.96
Experiment stations	do	27	740	1	1894	25,223.50	22,381.85	2,841.65
Inquiries relating to public roads	do	27	737	1	1894	10,000.00	2,997.39	7,002.61
Experiments in the manufacture of sugar	do	27	741	1	1894	20,107.33	9,451.80	10,655.53
Irrigation investigations	do	27	741	1	1894	6,000.00	5,475.92	524.08
Quarantine stations	do	27	740	1	1894	15,000.00	6,263.92	8,736.08
Bureau of Animal Industry	do	27	740	1	1894	850,000.00	496,111.34	353,888.66
Weather Bureau	do	27	741	1	1894	951,124.75	811,256.73	139,868.02
Salaries	Aug. 18, 1894	28	266	1	1895	249,876.16	204,589.72	45,286.44
Collecting agricultural statistics	do	28	266	1	1895	110,000.00	95,125.67	14,874.33
Botanical investigations and experiments	do	28	267	1	1895	30,000.00	25,695.30	4,304.70
Ivestigating the history and habits of insects	do	28	267	1	1895	20,300.00	16,822.87	3,477.13
Investigations in ornithology, etc	do	28	267	1	1895	17,500.00	15,526.35	1,973.65
Pomological information	do	28	267	1	1895	5,000.00	4,920.23	79.77
Microscopical investigations	do	28	267	1	1895	2,000.00	313.87	1,686.13
Vegetable pathological investigations, etc	do	28	267	1	1895	20,000.00	19,063.69	936.31
Laboratory	do	28	267	1	1895	14,900.00	11,010.50	3,889.50
Fiber investigations	do	28	271	1	1895	5,000.00	3,973.81	1,026.19
Report on forestry	do	28	268	1	1895	20,000.00	19,908.23	91.77
Illustrations and engravings	do	28	268	1	1895	15,000.00	9,114.71	5,855.29
Purchase and distribution of valuable seeds	do	28	269	1	1895	165,400.00	120,545.15	44,854.85
Document and folding room	do	28	268	1	1895	2,000.00	1,166.83	833.17
Experimental gardens and grounds	do	28	268	1	1895	29,500.00	23,578.11	5,921.89
Museum	do	28	271	1	1895	3,000.00	1,889.73	1,110.27
Furniture, cases, and repairs	do	28	271	1	1895	10,000.00	7,952.27	2,047.73
Library	do	28	272	1	1895	6,000.00	5,963.20	36.80
Postage	do	28	271	1	1895	5,000.00	765.00	4,235.00
Nutrition investigations	do	28	271	1	1895	10,000.00	9,746.30	253.70

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Contingent expenses	Aug. 18, 1894	28	272	1	1895	$25,000.00	$20,452.79	$4,547.21
Agricultural experiment stations	do	28	271	1	1895	25,000.00	24,928.22	71.78
Inquiries relating to public roads	do	28	266	1	1895	10,000.00	6,901.66	3,098.34
Experiments in the manufacture of sugar	do	28	271	1	1895	10,000.00	6,188.80	3,811.20
Irrigation investigations	do	28	271	1	1895	6,000.00	3,904.88	2,095.12
Quarantine stations for neat cattle	do	28	269	1	1895	12,000.00	6,262.17	5,737.83
Bureau of Animal Industry	do	28	269	1	1895	800,000.00	534,028.38	265,971.62
Weather Bureau	do	28	272	1	1895	878,438.84	820,691.94	57,746.90
Salaries	Mar. 2, 1895	28	727	1	1896	252,840.00	217,066.97	35,773.03
Collecting agricultural statistics	do	28	729	1	1896	110,000.00	68,628.99	41,371.01
Inquiries relating to public roads	do	28	729	1	1896	10,000.00	9,568.39	431.61
Botanical investigations and experiments	do	28	730	1	1896	25,000.00	20,325.37	4,674.63
Investigating the history and habits of insects	do	28	730	1	1896	20,000.00	17,372.43	2,627.57
Investigations in ornithology and mammalogy	do	28	730	1	1896	17,500.00	16,175.45	1,324.55
Pomological information	do	28	730	1	1896	6,000.00	4,996.41	1,003.59
Microscopical investigations	do	28	730	1	1896	2,000.00		2,000.00
Vegetable pathological investigations and experiments	do	28	730	1	1896	20,000.00	18,539.18	1,460.82
Laboratory	do	28	730	1	1896	14,900.00	11,458.53	3,441.47
Report on forestry	do	28	731	1	1896	25,000.00	18,398.12	6,601.88
Illustrations and engravings	do	28	731	1	1896	15,000.00	12,985.71	2,014.29
Document and folding room	do	28	731	1	1896	2,000.00	1,061.23	938.77
Experimental gardens and grounds	do	28	731	1	1896	29,500.00	22,371.15	7,128.85
Quarantine stations for neat cattle	do	28	733	1	1896	12,000.00	6,492.05	5,507.95
Purchase and distribution of valuable seeds	do	28	733	1	1896	185,400.00	126,476.87	58,923.13
Experiments in the manufacture of sugar	do	28	734	1	1896	10,000.00	1,510.94	8,489.06
Agricultural experiment stations ($750,000[a])	do	28	734	1	1896	[b] 30,143.75	27,712.86	2,430.89
Irrigation investigations	do	28	735	1	1896	15,000.00	5,029.82	9,970.18
Nutrition investigations	do	28	735	1	1896	15,000.00	14,892.96	107.04
Investigations and experiments with grasses and forage plants	do	28	735	1	1896	15,000.00	13,329.47	1,670.53
Investigations in relation to agricultural soils	do	28	735	1	1896	15,000.00	13,524.84	1,475.16
Furniture, cases, and repairs	do	28	735	1	1896	10,000.00	8,645.98	1,354.02
Postage	do	28	735	1	1896	2,000.00	1,215.00	785.00
Museum	do	28	735	1	1896	3,000.00	2,161.90	838.10
Fiber investigations	do	28	735	1	1896	5,000.00	3,710.36	1,289.64
Library	do	28	735	1	1896	6,000.00	5,431.92	568.08
Contingent expenses	do	28	736	1	1896	25,000.00	15,912.71	9,087.29
Bureau of Animal Industry	do	28	731	1	1896	800,000.00	595,336.64	204,663.36
Weather Bureau	do	28	736	1	1896	[c] 885,729.47	814,584.17	71,145.30
Salaries	Apr. 25, 1896	29	99	1	1897	313,860.00	290,791.95	23,068.05
Furniture, cases, and repairs	do	29	105	1	1897	12,000.00	9,567.59	2,432.41
Library	do	29	104	1	1897	7,000.00	6,831.15	168.85
Museum	do	29	105	1	1897	3,000.00	2,895.45	104.55
Postage	do	29	105	1	1897	3,000.00	1,730.00	1,270.00
Contingent expenses	do	29	105	1	1897	25,000.00	22,980.29	2,019.71
Animal quarantine stations	do	29	105	1	1897	12,000.00	6,564.19	5,435.81
Collecting agricultural statistics	do	29	101	1	1897	110,000.00	83,067.62	26,932.38
Botanical investigations and experiments	do	29	101	1	1897	15,000.00	14,999.64	.36
Entomological investigations	do	29	102	1	1897	20,000.00	18,637.01	1,362.99
Vegetable pathological investigations	do	29	102	1	1897	20,000.00	19,274.15	725.85
Biological investigations	do	29	102	1	1897	17,500.00	17,483.05	16.95
Pomological investigations	do	29	102	1	1897	6,000.00	4,981.52	1,018.48

[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.

[b] Includes $143.75 from the sale of card index.

[c] Includes $119.47 from the sale of Weather Bureau publications.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Laboratory	Apr. 25, 1896	29	102	1	1897	$12,400.00	$10,800.18	$1,599.82
Forestry investigations	....do....	29	103	1	1897	20,000.00	19,514.88	485.12
Experimental gardens and grounds	....do....	29	103	1	1897	20,000.00	19,483.28	516.72
Soil investigations	....do....	29	103	1	1897	10,000.00	9,868.16	131.84
Grass and forage plant investigations	....do....	29	103	1	1897	10,000.00	9,203.14	796.86
Fiber investigations	....do....	29	103	1	1897	5,000.00	4,143.00	857.00
Agricultural experiment stations ($750,000) [a]	....do....	29	103	1	1897	[b] 30,127.25	29,171.57	955.68
Nutrition investigations	....do....	29	104	1	1897	15,000.00	14,821.64	178.36
Public road inquiries	....do....	29	104	1	1897	8,000.00	7,873.97	126.03
Publications	....do....	29	104	1	1897	70,000.00	67,709.89	2,290.11
Purchase and distribution of valuable seeds	....do....	29	106	1	1897	150,000.00	142,822.52	7,177.48
Bureau of Animal Industry	....do....	29	106	1	1897	650,000.00	642,715.68	7,284.32
Weather Bureau	....do....	29	107	1	1897	[c] 883,876.28	870,581.46	13,294.82
Salaries, officers and clerks	Apr. 23, 1897	30	1	1	1898	319,300.00	285,181.30 18,962.98 9,811.02	5,118.70 37.02 188.98
Furniture, cases, and repairs	....do....	30	8	1	1898	9,000.00	7,851.30	1,148.70
Library	....do....	30	7	1	1898	7,000.00	6,734.81	265.19
Museum	....do....	30	8	1	1898	3,000.00	2,906.02	93.98
Postage	....do....	30	8	1	1898	3,000.00	1,500.00	1,500.00
Contingent expenses	....do....	30	8	1	1898	25,000.00	22,061.73	2,938.27
Animal quarantine stations	....do....	30	7	1	1898	12,000.00	10,897.98	1,102.02
Collecting agricultural statistics	....do....	30	3	1	1898	110,000.00	92,896.01 9,021.09	7,103.99 978.91
Botanical investigations and experiments	....do....	30	4	1	1898	15,000.00	14,714.50	285.50
Entomological investigations	....do....	30	4	1	1898	20,000.00	19,735.02	264.98
Vegetable pathological investigations	....do....	30	4	1	1898	20,000.00	18,966.67 660.00	373.33 ....
Biological investigations	....do....	30	4	1	1898	17,500.00	16,160.90	1,339.10
Pomological investigations	....do....	30	4	1	1898	8,000.00	7,487.93	512.07
Laboratory	....do....	30	5	1	1898	12,400.00	3,913.86 900.00 6,718.71	86.14 .... 781.29
Forestry investigations	....do....	30	5	1	1898	20,000.00	19,831.32	168.68
Experimental gardens and grounds	....do....	30	5	1	1898	25,000.00	24,937.31	62.69
Soil investigations	....do....	30	5	1	1898	10,000.00	9,199.82 660.00	140.18 ....
Grass and forage plant investigations	....do....	30	6	1	1898	10,000.00	8,877.68	1,122.32
Fiber investigations	....do....	30	6	1	1898	5,000.00	3,659.05	1,340.95
Agricultural experiment stations ($755,000 [a])	....do....	30	6	1	1898	35,000.00	29,413.10 4,925.80	586.90 74.20
Nutrition investigations	....do....	30	6	1	1898	15,000.00	14,872.88	127.12
Public road inquiries	....do....	30	7	1	1898	8,000.00	7,978.44	21.56
Publications, including Farmers' Bulletins	....do....	30	7	1	1898	65,000.00	34,966.55 29,812.59	33.45 187.41
Investigating production of domestic sugar	....do....	30	39	1	1898	5,000.00	4,941.32	58.68
Purchase and distribution of valuable seeds	....do....	30	8	1	1898	130,000.00	121,870.38	8,129.62
Salaries and expenses, Bureau of Animal Industry	....do....	30	9	1	1898	675,000.00	673,444.02 1,200.00	355.98 ....
Weather Bureau	....do....	30	9	1	1898	883,702.00	877,838.35	5,863.65
Salaries, officers and clerks	Mar. 22, 1898	30	330	1	1899	319,300.00	315,986.70	3,313.30
Furniture, cases, and repairs	....do....	30	336	1	1899	9,000.00	8,667.75	332.25
Library	....do....	30	336	1	1899	6,000.00	5,659.51	340.49
Museum	....do....	30	336	1	1899	1,500.00	1,465.36	34.64
Postage	....do....	30	336	1	1899	2,000.00	2,000.00	....
Contingent expenses	....do....	30	337	1	1899	25,000.00	23,888.08	1,111.92
Animal quarantine stations	....do....	30	336	1	1899	12,000.00	11,833.38	166.62
Collecting agricultural statistics	....do....	30	333	1	1899	105,000.00	100,952.48	4,047.52
Botanical investigations and experiments	....do....	30	333	1	1899	20,000.00	19,972.07	27.93

[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.

[b] Includes $127.25 from the sale of card index.

[c] Includes $104.28 from the sale of Weather Bureau publications.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Entomological investigations	Mar. 22, 1898	30	333	1	1899	$20,000.00	$19,812.64	$187.36
Vegetable pathological investigations	do	30	333	1	1899	20,000.00	19,634.32	365.68
Biological investigations	do	30	334	1	1899	17,500.00	17,373.26	126.74
Pomological investigations	do	30	334	1	1899	9,500.00	8,248.18	1,251.82
Laboratory	do	30	334	1	1899	12,400.00	12,028.15	371.85
Forestry investigations	do	30	334	1	1899	20,000.00	19,520.52	469.48
Experimental gardens and grounds	do	30	334	1	1899	20,000.00	19,879.66	120.34
Soil investigations	do	30	334	1	1899	10,000.00	9,885.85	114.15
Grass and forage plant investigations	do	30	335	1	1899	10,000.00	9,950.99	49.01
Irrigation information	do	30	335	1	1899	10,000.00	9,997.49	2.51
Agricultural experiment stations ($760,000 [a])	do	30	335	1	1899	40,000.00	39,536.38	463.62
Nutrition investigations	do	30	335	1	1899	15,000.00	14,903.08	96.92
Public road inquiries	do	30	336	1	1899	8,000.00	7,469.50	530.50
Publications	do	30	336	1	1899	65,000.00	64,773.62	226.38
Purchase and distribution of valuable seeds	do	30	337	1	1899	130,000.00	128,350.61	1,649.39
Investigating production of domestic sugar	do	30	338	1	1899	7,000.00	6,860.30	139.70
Salaries and expenses, Bureau of Animal Industry	do	30	338	1	1899	900,000.00	[b] 920,164.47	6,828.45
Weather Bureau	do	30	339	1	1899	1,015,502.00	1,008,971.30	6,530.70
Salaries, officers and clerks	Mar. 1, 1899	30	947	1	1900	336,340.00	330,666.24	5,673.76
Furniture, cases, and repairs	do	30	955	1	1900	10,000.00	9,771.27	228.73
Library	do	30	954	1	1900	5,000.00	4,291.17	708.83
Museum	do	30	954	1	1900	1,500.00	1,490.01	9.99
Postage	do	30	954	1	1900	2,000.00	2,000.00	....
Contingent expenses	do	30	955	1	1900	25,000.00	23,769.38	1,230.62
Animal quarantine stations	do	30	954	1	1900	12,000.00	11,477.87	522.13
Collecting agricultural statistics	do	30	950	1	1900	110,000.00	107,653.62	2,346.38
Botanical investigations and experiments	do	30	950	1	1900	20,000.00	19,689.51	310.49
Entomological investigations	do	30	951	1	1900	20,000.00	19,920.64	79.36
Vegetable pathological investigations	do	30	951	1	1900	26,000.00	25,854.44	145.56
Biological investigations	do	30	951	1	1900	17,500.00	17,344.00	156.00
Pomological investigations	do	30	951	1	1900	9,500.00	9,099.61	400.39
Laboratory	do	30	951	1	1900	17,700.00	17,182.80	517.20
Forestry investigations	do	30	952	1	1900	40,000.00	39,991.49	8.51
Experimental gardens and grounds	do	30	952	1	1900	28,000.00	27,589.66	410.34
Soil investigations	do	30	952	1	1900	20,000.00	19,717.02	282.98
Grass and forage plant investigations	do	30	952	1	1900	12,000.00	11,566.84	433.16
Irrigation investigations	do	30	953	1	1900	35,000.00	33,732.57	1,267.43
Agricultural experiment stations ($765,000 [a])	do	30	953	1	1900	45,000.00	43,702.20	1,297.80
Nutrition investigations	do	30	953	1	1900	15,000.00	14,950.86	49.14
Public road inquiries	do	30	954	1	1900	8,000.00	7,854.35	145.65
Publications	do	30	954	1	1900	80,000.00	79,516.76	483.24
Purchase and distribution of valuable seeds	do	30	955	1	1900	130,000.00	128,366.13	1,633.87
Investigating production of domestic sugar	do	30	956	1	1900	7,000.00	6,717.82	282.18
Tea-culture investigations	do	30	956	1	1900	1,000.00	999.33	.67
Salaries and expenses, Bureau of Animal Industry	do	30	956	1	1900	950,000.00	918,449.03	31,550.97
Weather Bureau	do	30	957	1	1900	1,022,482.00	1,014,238.80	8,243.20
Salaries, officers and clerks	May 20, 1900	31	191	1	1901	326,680.00	319,809.25	6,870.75
Library	do	31	194	1	1901	5,000.00	4,118.93	881.07
Contingent expenses	do	31	194	1	1901	37,000.00	35,623.95	1,376.05
Animal quarantine stations	do	31	194	1	1901	50,000.00	49,343.52	656.48
Collecting agricultural statistics	do	31	194	1	1901	110,000.00	109,729.76	270.24
Botanical investigations and experiments	do	31	195	1	1901	30,000.00	29,590.49	409.51
Entomological investigations	do	31	195	1	1901	22,500.00	22,265.57	234.43
Vegetable pathological investigations	do	31	195	1	1901	28,000.00	27,488.57	511.43

[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.

[b] Includes $26,992.92 received from sale of American products in Europe.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Biological investigations	Mar. 1, 1899	31	196	1	1901	$17,500.00	$17,195.83	$304.17
Pomological investigations	do	31	196	1	1901	9,500.00	9,315.11	184.89
Laboratory	do	31	196	1	1901	28,500.00	28,395.45	104.55
Forestry investigations	do	31	197	1	1901	80,000.00	79,695.87	304.13
Experimental gardens and grounds	do	31	197	1	1901	20,000.00	19,986.72	13.28
Soil investigations	do	31	197	1	1901	25,000.00	24,924.94	75.06
Grass and forage plant investigations	do	31	198	1	1901	17,000.00	15,225.83	1,774.17
Irrigation investigations	do	31	199	1	1901	50,000.00	49,973.09	26.91
Agricultural experiment stations ($780,000[a])	do	31	198	1	1901	[b] 60,251.01	59,883.47	367.54
Nutrition investigations	do	31	199	1	1901	17,500.00	17,499.67	.33
Arlington experimental farm	do	31	199	1	1901	10,000.00	9,946.03	53.97
Public road inquiries	do	31	200	1	1901	14,000.00	13,990.76	9.24
Publications	do	31	200	1	1901	105,000.00	104,680.67	319.33
Purchase and distribution of valuable seeds	do	31	200	1	1901	170,000.00	149,615.49	20,384.51
Investigating production of domestic sugar	do	31	201	1	1901	7,000.00	6,690.25	309.75
Tea-culture investigations	do	31	202	1	1901	5,000.00	4,959.42	40.58
Salaries and expenses, Bureau of Animal Industry	do	31	202	1	1901	[c]1,000,514.96	976,566.75	23,948.21
Salaries, Weather Bureau	do	31	202	1	1901	153,320.00	152,688.11	631.89
Fuel, lights, and repairs, Weather Bureau	do	31	203	1	1901	9,000.00	8,877.36	122.64
Contingent expenses, Weather Bureau	do	31	203	1	1901	8,000.00	7,906.40	93.60
General expenses, Weather Bureau	do	31	203	1	1901	828,000.00	823,921.78	4,078.22
Meteorological Observation Stations, Weather Bureau	do	31	204	1	1901	60,000.00	59,019.49	980.51
Salaries	Mar. 2, 1901	31	922	1	1902	373,820.00	370,039.69	3,780.31
Library	do	31	934	1	1902	7,000.00	6,754.06	245.94
Contingent expenses	do	31	934	1	1902	37,000.00	34,543.24	2,456.76
Animal quarantine stations	do	31	926	1	1902	25,000.00	24,814.88	185.12
Collecting agricultural statistics	do	31	934	1	1902	120,000.00	117,060.06	2,939.94
Botanical investigations and experiments	do	31	928	1	1902	45,000.00	44,950.93	49.07
Entomological investigations	do	31	931	1	1902	28,513.18	27,069.77	1,443.41
Vegetable pathological investigations	do	31	927	1	1902	60,000.00	59,999.45	.55
Biological investigations	do	31	932	1	1902	20,000.00	19,807.80	192.20
Pomological investigations	do	31	927	1	1902	20,000.00	19,985.14	14.86
Laboratory	do	31	930	1	1902	24,500.00	24,417.47	82.53
Forestry investigations	do	31	929	1	1902	146,280.00	145,809.76	470.24
Experimental gardens and grounds	do	31	929	1	1902	20,000.00	19,725.80	274.20
Soil investigations	do	31	931	1	1902	91,000.00	89,987.21	1,012.79
Grass and forage plant investigations	do	31	928	1	1902	20,000.00	19,566.91	433.09
Irrigation investigations	do	31	936	1	1902	50,000.00	49,980.86	19.14
Agricultural experiment stations ($780,000[a])	do	31	935	1	1902	[d] 69,157.05	69,052.71	104.34
Nutrition investigations	do	31	936	1	1902	20,000.00	19,951.48	48.52
Arlington experimental farm	do	31	936	1	1902	10,000.00	9,897.16	102.84
Plans for building Department of Agriculture, 1901-2	do	31	938	1	1902	5,000.00	5,000.00	....
Public road inquiries	do	31	938	1	1902	20,000.00	19,957.01	42.99
Publications	do	31	933	1	1902	188,000.00	187,657.52	342.48
Purchase and distribution of valuable seeds	do	31	937	1	1902	270,000.00	266,614.22	3,385.78
Investigating production of domestic sugar	do	31	936	1	1902	5,000.00	4,346.31	653.69
Tea-culture investigations	do	31	937	1	1902	7,000.00	6,816.25	183.75
Bureau of Animal Industry	do	31	925	1	1902	1,092,190.28	1,092,100.94	89.34
Weather Bureau:								
Salaries	do	31	923	1	1902	159,820.00	159,769.71	50.59
Fuel, lights, and repairs	do	31	923	1	1902	9,000.00	8,919.71	80.29

[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.

[b] Including $251.01 received from sales of card index.

[c] Including $514.96 received from sales of American butter in foreign markets.

[d] Including $157.05 received from sales of card index.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Weather Bureau—Continued.								
Contingent expenses	Mar. 2, 1901	31	923	1	1902	$8.000.00	$7,942.81	$57.19
General expenses	do	31	923	1	1902	865.500.00	864,490.74	1,009.26
Meteorological observation stations	do	31	924	1	1902	60,000.00	59,646.49	353.51
Buildings	do	31	924	1	1902	46,000.00	46,000.00	....
Salaries	June 3, 1902	32	286	1	1903	465,500.00	450,976.17	14,523.83
Library	do	32	300	1	1903	8,000.00	7,635.11	364.89
Contingent expenses	do	32	301	1	1903	37,000.00	42,916.14	83.86
Urgent deficiency, contingent	do	32	1062	1	1903	6,000.00		
Vegetable pathological investigations	do	32	291	1	1903	105,000.00	103,646.28	1,353.72
Vegetable pathological investigations, 1902–3	do	32	1152	1	1903	5,000.00	4,130.02	869.98
Pomological investigations	do	32	291	1	1903	30,000.00	29,606.83	393.17
Botanical investigations and experiments	do	32	292	1	1903	55,000.00	54,900.42	99.58
Grass and forage plant investigations	do	32	292	1	1903	30,000.00	29,527.41	472.59
Experimental gardens and grounds	do	32	293	1	1903	25,000.00	24,935.74	64.26
Arlington Experimental Farm	do	32	293	1	1903	15,000.00	14,998.81	1.19
Investigating production of domestic sugar	do	32	295	1	1903	5,000.00	4,065.10	934.90
Tea-culture investigations	do	32	293	1	1903	10,000.00	7,500.10	2,499.90
Purchase and distribution of valuable seeds	do	32	293	1	1903	270,000.00	266,229.81	3,770.19
Forestry investigations	do	32	295	1	1903	254,000.00	244,781.68	9,218.32
Laboratory	do	32	296	1	1903	60,500.00	59,518.91	918.09
Soil investigations	do	32	297	1	1903	130,000.00	128,408.15	1,591.85
Entomological investigations	do	32	298	1	1903	37,500.00	37,485.44	14.56
Entomological investigations, 1902–3	do	32	298	1	1903	8,000.00	7,989.42	10.58
Biological investigations	do	32	298	1	1903	26,000.00	25,616.80	383.20
Biological investigations, 1902–3	do	32	298	1	1903	2,000.00	1,949.61	50.39
Urgent deficiency publications	do	32	1062	1	1903	200,000.00 4,000.00	190,961.49	13,038.51
Collecting agricultural statistics	do	32	300	1	1903	94,200.00	94,023.27	176.73
Agricultural experiment stations ($796,000[a])	do	32	301	1	1903	76,000.00	77,552.69	333.31
Amount of deposits	do	32	301	1	1903	[b] 1,886.00		
Nutrition investigations	do	32	302	1	1903	20,000.00	19,901.12	98.88
Irrigation investigations	do	32	302	1	1903	65,000.00	62,201.12	2,798.88
Public road inquiries	do	32	302	1	1903	30,000.00	29,996.13	3.87
Foreign market investigations	do	32	300	1	1903	6,500.00	6,140.02	359.98
Silk investigations	do	32	303	1	1903	10,000.00	7,133.32	2,866.68
Expenses, Bureau of Animal Industry	do	32	289	1	1903	1,660,000.00	1,444,113.05	215,886.95
Urgent deficiency, Bureau of Animal Industry	do	32	1165	1	1903	500,000.00		
Weather Bureau:								
Salaries	do	32	286	1	1903	165,260.00	164,927.46	332.54
Fuel, lights, and repairs	do	32	287	1	1903	10,000.00	9,964.65	35.35
Contingent expenses	do	32	287	1	1903	8,000.00	7,806.38	193.62
General expenses	do	32	287	1	1903	915,000.00	428,219.24 480,377.71	1,280.76 5,622.29
Meteorological observation stations	do	32	288	1	1903	60,000.00	59,628.24	371.76
Buildings	do	32	288	1	1903	50,000.00	49,467.00	533.00
Cables and land lines	do	32	288	1	1903	40,000.00	40,000.00	....
Storm-warning stations, Glenhaven and South Manitou Island, Mich	do	32	288	1	1903	15,000.00	15,000.00	....
Salaries, Department of Agriculture, officers and clerks	Mar. 3, 1903	32	1147	1	1904	470,080.00	458,295.90	11,784.10
Salaries, extra laborers	do	32	1147	1	1904	1,000.00	982.01	17.99
Bureau of Animal Industry:								
General expenses, including $1,800 for rent of building	do	32	1150	1	1904	1,200,000.00	1,199,410.98	589.02
To eradicate contagious diseases of animals	do	.....	.....	.....	.....	250,000.00	249,868.64	131.06

[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.
[b] Receipts from sales of certain products of Alaska, Hawaii, and Porto Rico experiment stations.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Bureau of Plant Industry:								
Vegetable pathological investigations	Mar. 3, 1903	32	1152	1	1904	$122,000.00	$122,889.98	$0.06
Rent of building	do	32	1152	1	1904	3,000.00	2,109.96	
Vegetable pathological investigations, 1903–4	do	32	1152	1	1904	5,000.00	4,998.41	1.59
Pomological investigations	do	32	1153	1	1904	37,000.00	35,636.08	1,363.92
Botanical investigations and experiments	do	32	1153	1	1904	62,000.00	60,693.23	1,306.77
Rent of building	do	32	1153	1	1904	3,000.00	3,000.00	....
Grass and forage plant investigations	do	32	1154	1	1904	33,800.00	34,514.48	235.52
Rent of building	do	32	1154	1	1904	1,200.00	250.00	
Experimental gardens and grounds, Department of Agriculture	do	32	1154	1	1904	25,000.00	24,984.11	15.89
Arlington Experimental Farm	do	32	1155		1904	15,000.00	14,972.99	27.01
Tea-culture investigations	do	32	1155	1	1904	10,000.00	8,701.07	1,298.93
Purchase and distribution of valuable seeds	do	32	1155	1	1904	257,000.00	257,247.74	256.26
Foreign seed and plant introduction	do	32	1155	1	1904	30,000.00	27,483.93	2,012.07
Rent of building	do	32	1156	1	1904	3,000.00	....	3,000.00
Investigating production of domestic sugar	do	32	1156	1	1904	5,000.00	4,249.41	750.59
Bureau of Forestry:								
Forestry investigations, including $10,000 for rent of building	do	32	1156	1	1904	312,860.00	311,588.63	1,271.37
Protection of forest reserves[a]	do	....	......	...	......	16,864.01	341.12	16,522.89
Bureau of Chemistry:								
Laboratory, including $5,000 for table sirup	do	32	1157	1	1904	60,500.00	60,317.39	182.61
Laboratory, table sirup, 1903–4	do	32	1157	1	1904	10,000.00	9,898.89	101.11
Bureau of Soils, including $2,000 for rent of building	do	32	1159	1	1904	170,000.00	166,286.32	3,713.68
Entomological investigations	do	32	1160	1	1904	43,500.00	39,114.76	4,385.24
Silk investigations	do	32	1160	1	1904	10,000.00	9,055.31	944.69
Entomological investigations, 1903–4	do	32	1160	1	1904	12,000.00	11,825.82	174.18
Biological investigations, including $1,000 for care of game	do	32	1160	1	1904	34,000.00	33,066.92	933.08
Publications, Department of Agriculture, Farmers' Bulletins	do	32	1161	1	1904	105,000.00	104,997.90	2.10
Artists, etc	do	32	1161	1	1904	10,000.00	9,992.49	7.51
Labor, etc	do	32	1161	1	1904	85,000.00	84,746.73	253.27
Collecting agricultural statistics	do	32	1162	1	1904	104,200.00	103,225.90	974.10
Collecting agricultural statistics, 1903–4	do	32	1162	1	1904	5,000.00	4,996.84	3.16
Foreign-market investigations	do	32	1162	1	1904	7,500.00	7,455.40	44.60
Library, Department of Agriculture	do	32	1163	1	1904	10,000.00	9,972.93	27.07
Contingent expenses, Department of Agriculture	do	32	1163	1	1904	37,000.00	36,999.77	.23
Agricultural experiment stations ($810.000[b])	do	32	1163	1	1904	40,000.00	39,997.74	2.26
Stations of Alaska	do	32	1164	1	1904	15,000.00	15,000.00	....
Stations of Hawaii	do	32	1164	1	1904	15,000.00	15,000.00	....
Stations of Porto Rico	do	32	1164	1	1904	15,000.00	15,000.00	....
Farmers' institutes	do	32	1164	1	1904	5,000.00	4,838.69	161.31
Nutrition investigations	do	32	1164	1	1904	20,000.00	19,994.18	5.82
Irrigation investigations	do	32	1165	1	1904	65,000.00	64,938.65	61.35
Public road inquiries	do	32	1165	1	1904	32,000.00	31,813.00	187.00
Public road inquiries, 1903–4	do	32	1165	1	1904	3,000.00	3,000.00	....

[a] This appropriation and amount transferred from Department of Interior.

[b] Of this amount, $720,000 is paid directly to the experiment stations from the Treasury Department.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Weather Bureau:								
Salaries	Mar. 3, 1903	32	1148	1	1904	$175,440.00	$175,098.94	$341.06
Fuel, lights, and repairs	do	32	1148	1	1904	6,000.00	5,981.63	18.37
Contingent expenses	do	32	1148	1	1904	8,000.00	7,818.52	181.48
General expenses, salaries	do	32	1149	1	1904	472,300.00	471,917.22	382.78
General expenses, miscellaneous	do	32	1149	1	1904	496,780.00	494,741.03	2,038.97
Buildings	do	32	1149	1	1904	50,000.00	50,000.00	....
Cables and land lines	do	23	1149	1	1904	40,000.00	40,000.00	....
Salaries, officers and clerks	Apr. 23, 1904	33	276	1	1905	481,300.00	407,998.89	10,301.11
Salaries, extra laborers	do	33	277	1	1905	1,000.00	971.66	28.34
Bureau of Animal Industry:								
Deficiency appropriation	do	33	1242	1	1905	150,000.00	1,399,227.96	772.04
General expenses, including $1,800 for rent of building	do	33	279	1	1905	1,250,000.00		
Animal breeding and feeding	do	33	281	1	1905	25,000.00	20,540.67	4,459.33
To eradicate contagious diseases of animals, 1904–5[c]	do	33	5	1	1905	250,000.00	248,980.79	1,019.21
Bureau of Plant Industry:								
Vegetable pathological investigations	do	33	281	1	1905	145,000.00	145,705.01	....
Rent of building	do	33	281	1	1905	3,000.00	2,294.99	....
Vegetable pathological investigations, 1904–5	do	33	281	1	1905	2,000.00	2,000.00	....
Rent of quarters (deficiency)	do	33	603	1	1905	2,500.00	2,485.00	15.00
Pomological investigations[a]	do	33	282	1	1905	43,500.00	41,280.58	2,219.42
Botanical investigations and experiments	do	33	283	1	1905	64,500.00	63,914.24	585.76
Rent of building	do	33	283	1	1905	3,000.00	3,000.00	....
Grass and forage plant investigations	do	33	283	1	1905	40,500.00	40,012.04	487.96
Rent of building	do	33	283	1	1905	2,000.00	1,500.00	500.00
Experimental gardens and grounds, Department of Agriculture	do	33	284	1	1905	25,000.00	24,725.40	274.60
Greenhouses, Department of Agriculture, 1904–5	do	33	284	1	1905	25,000.00	24,995.32	4.68
Arlington Experimental Farm	do	33	284	1	1905	20,000.00	19,838.70	161.30
Tea-culture investigations	do	33	284	1	1905	10,000.00	8,387.15	1,612.85
Purchase and distribution of valuable seeds[b]	do	33	285	1	1905	242,500.00	240,379.71	2,120.29
Foreign seed and plant introduction[b]	do	33	286	1	1905	40,000.00	39,687.44	312.56
Repairs to building	do	33	285	1	1905	7,500.00	4,000.00	3,500.00
Investigating production of domestic sugar	do	33	286	1	1905	7,500.00	7,222.14	277.86
Bureau of Forestry:								
Forestry investigations, including $15,500 for rent of building	do	33	286	1	1905	388,000.00	386,618.32	1,381.68
Protection of Forest Reserves	do	33	286	1	1905	50,000.00	49,025.23	974.77
Testing timbers, Louisiana Purchase Exposition, St. Louis, Mo. (deficiency act)	do	33	1242	1	1905	10,000.00	9,985.82	14.18
Bureau of Chemistry:								
Laboratory, including $15,000 for table sirup	do	33	287	1	1905	105,000.00	103,693.95	1,306.05
Laboratory, 1904–5	do	33	288	1	1905	15,000.00	14,716.95	283.05
Laboratory road materials	do	33	288	1	1905	15,000.00	14,802.99	197.01
Bureau of Soils:								
Soil investigations, including $6,000 for rent of building	do	33	288	1	1905	170,000.00	168,638.84	1,361.16
Entomological investigations	do	33	289	1	1905	70,000.00	69,124.44	875.56
Cotton boll-weevil investigations, 1904–5[c]	do	33	5	1	1905	250,000.00	220,685.40	29,314.60

[a] By receipts from sale of fruits and vegetables (Pomological investigations) $2,426.21

[b] By transfer from foreign to domestic seeds 4,183.54

[c] By transfer from cotton boll weevil to Bureau of Animal Industry, 1904–5 .... 3,500.00

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Biological investigations	Apr. 23, 1904	33	290	1	1905	$33,000.00	$32,937.70	$62.30
Biological investigations, 1904–5, care of elk	do	33	291	1	1905	1,000.00	807.14	192.86
Publications, Department of Agriculture, Farmers' Bulletins	do	33	291	1	1905	105,000.00	104,885.16	114.84
Artists, etc	do	33	291	1	1905	15,000.00	14,635.28	364.72
Labor, etc	do	33	291	1	1905	89,000.00	88,985.64	14.36
Labor, etc., 1904–5	do	33	291	1	1905	1,000.00	430.64	569.36
Collecting agricultural statistics	do	33	292	1	1905	132,000.00	130,539.73	1,460.27
Foreign-market investigations	do	33	292	1	1905	7,500.00	6,069.72	1,430.28
Library, Department of Agriculture	do	33	293	1	1905	10,000.00	9,640.28	359.72
Contingent expenses, Department of Agriculture	do	33	293	1	1905	37,000.00	36,963.20	36.80
Agricultural experiment stations ($810,000[a])	do	33	293	1	1905	40,000.00	39,703.10	296.90
Stations of Alaska	do	33	294	1	1905	15,000.00	15,000.00	....
Stations of Hawaii	do	33	294	1	1905	15,000.00	15,000.00	....
Stations of Porto Rico	do	33	294	1	1905	15,000.00	15,000.00	....
Farmers' institutes	do	33	294	1	1905	5,000.00	4,603.53	396.47
Nutrition investigations	do	33	294	1	1905	20,000.00	19,976.98	23.02
Irrigation investigations	do	33	294	1	1905	67,500.00	67,416.35	83.65
Public road inquiries	do	33	295	1	1905	35,000.00	34,319.03	680.97
Building, Department of Agriculture	do	32	806	1	1905	250,000.00	108,496.32	141,503.68
Weather Bureau:								
Salaries	do	33	277	1	1905	180,440.00	180,225.57	214.43
Fuel, lights, and repairs	do	33	278	1	1905	8,000.00	7,979.20	20.80
Contingent expenses	do	33	278	1	1905	10,000.00	9,702.60	297.40
General expenses, salaries	do	33	278	1	1905	492,300.00	491,725.31	574.69
General expenses, miscellaneous	do	33	279	1	1905	572,000.00	569,424.01	2,575.99
Buildings	do	33	279	1	1905	48,000.00	47,803.11	196.89
Cables and land lines	do	33	279	1	1905	27,000.00	26,991.09	8.91
Salaries, officers and clerks	Mar. 3, 1905	33	861	1	1906	804,970.00	783,042.64	21,927.36
Salaries, extra labor	do	33	861	1	1906	10,000.00	9,120.34	879.66
Bureau of Animal Industry:								
Deficiency act	Feb. 27, 1906	....	......	...	1906	....	....	....
General expenses (including $63,000 deficiency)	Mar. 3, 1905	33	864	1	1906	1,492,020.00	1,405,951.28	86,068.72
Animal breeding and feeding	do	33	866	1	1906	25,000.00	24,429.56	570.44
Rent of buildings	do	33	865	1	1906	2,500.00	1,802.00	698.00
Bureau of Plant Industry:								
Vegetable pathological investigations	do	33	867	1	1906	139,640.00	135,320.51	4,319.49
Rent of building	do	33	867	1	1906	6,000.00	3,720.00	2,280.00
Vegetable pathological investigations, 1905–6	do	33	868	1	1906	10,000.00	9,560.46	439.54
Grain investigations	do	33	868	1	1906	25,000.00	23,843.68	1,156.32
Pomological investigations	do	33	868	1	1906	33,640.00	33,639.62	.38
Rent of building	do	33	868	1	1906	2,000.00	2,000.00	....
Botanical investigations and experiments	do	33	869	1	1906	60,840.00	59,338.60	1,501.40
Rent of building	do	33	869	1	1906	3,000.00	3,000.00	....
Grass and forage plant investigations	do	33	869	1	1906	37,160.00	33,279.00	3,881.00
Rent of building	do	33	869	1	1906	2,500.00	2,490.00	10.00
Experimental gardens and grounds	do	33	870	1	1906	15,320.00	15,273.75	46.25
Experimental gardens and grounds, 1905–6	do	33	870	1	1906	5,000.00	4,978.00	22.00
Arlington experimental farm	do	33	870	1	1906	20,000.00	19,667.35	332.65
Tea-culture investigations	do	33	870	1	1906	8,500.00	7,944.83	555.17
Purchase and distribution of valuable seeds	do	33	870	1	1906	205,140.00	202,767.39	2,372.61
Foreign seed and plant introduction	do	33	871	1	1906	37,780.00	32,429.83	5,350.17
Investigating production of domestic sugar	do	33	872	1	1906	7,500.00	7,317.54	182.46

[a] Of this amount $720,000 was paid directly to the experiment stations from the Treasury Department.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Forest Service:								
General expenses, Forest Service	Mar. 3, 1905	33	872	1	1906	$768,180.00	$767,722.04	$457.96
Rent of buildings	do	33	873	1	1906	25,000.00	25,000.00	
Bureau of Chemistry:								
Laboratory, including $3,000 for table sirup	do	33	873	1	1906	130,920.00	128,289.99	2,630.01
Bureau of Soils:								
Soil investigations, including $4,000 for rent of building	do	33	875	1	1906	170,000.00	167,403.73	2,596.27
Bureau of Entomology:								
Entomological investigations, including $2,500 for moth investigations	do	33	876	1	1906	68,060.00	65,457.52	2,602.48
Bureau of Biological Survey:								
Biological investigations	do	33	877	1	1906	44,420.00	44,064.71	355.29
Division of Publications:								
Publications, Department of Agriculture, Farmers' Bulletins	do	33	878	1	1906	98,750.00	98,601.49	148.51
Artists, etc	do	33	878	1	1906	3,500.00	3,434.10	65.90
Labor, etc	do	33	879	1	1906	30,000.00	29,767.04	232.96
Bureau of Statistics:								
Collecting agricultural statistics	do	33	879	1	1906	93,900.00	90,007.12	3,892.88
Foreign market investigations	do	33	879	1	1906	4,900.00	4,720.13	179.87
Library, Department of Agriculture	do	33	880	1	1906	8,040.00	7,411.73	628.27
Contingent expenses, Department of Agriculture	do	33	880	1	1906	35,000.00	34,878.55	121.45
Contingent expenses, 1905–6	do	33	880	1	1906	2,000.00	2,000.00	
Agricultural experiment stations ($1,034,660)[a]	do	33	881	1	1906	21,660.00	20,908.90	751.10
Stations of Alaska, including $3,000 for purchase of live stock	do	33	881	1	1906	18,000.00	18,000.00	
Stations of Hawaii	do	33	881	1	1906	15,000.00	15,000.00	
Stations of Porto Rico	do	33	881	1	1906	15,000.00	15,000.00	
Farmers' institutes	do	33	882	1	1906	5,000.00	4,550.52	449.48
Nutrition investigations	do	33	882	1	1906	20,000.00	19,805.11	194.89
Irrigation investigations	do	33	882	1	1906	74,200.00	74,044.61	155.39
Public-road inquiries	do	33	882	1	1906	37,660.00	36,479.77	1,180.23
Cotton-boll weevil investigations	do	33	883	1	1906	190,000.00	154,671.59	35,328.41
Weather Bureau:								
Salaries	do	33	862	1	1906	191,430.00	190,930.72	499.28
Fuel, lights, and repairs	do	33	862	1	1906	10,000.00	9,926.33	73.67
Contingent expenses	do	33	863	1	1906	10,000.00	9,841.53	158.47
Salaries, station employees	do	33	863	1	1906	531,550.00	530,662.89	887.11
General expenses	do	33	863	1	1906	562,010.00	553,143.78	8,866.22
Buildings	do	33	863	1	1906	53,000.00	52,748.43	251.57
Cables and land lines	do	33	864	1	1906	35,000.00	34,121.31	878.69
Salaries, officers and clerks	June 30, 1906	34	670	1	1907	750,170.00	731,284.77	18,885.23
Salaries, extra labor	do	34	670	1	1907	7,600.00	6,430.73	1,169.27
Contingent expenses	do	34	692	1	1907	37,000.00	36,603.13	396.87
Library	do	34	691	1	1907	10,000.00	9,518.47	481.53
Bureau of Animal Industry:								
General expenses	do	34	673	1	1907	809,700.00	745,546.97	64,153.03
Rent of buildings	do	34	673	1	1907	2,500.00	2,481.00	19.00
Southern dairy work	do	34	674	1	1907	20,000.00	17,762.01	2,237.99
Diseases of domestic animals, Minnesota	do	34	674	1	1907	5,000.00	1,691.76	3,308.24
Animal breeding and feeding	do	34	674	1	1907	25,000.00	24,361.92	638.08
Meat inspection	do	34	674	1	1907	3,000,000.00	2,163,907.68	836,092.32
Eradicating cattle ticks:								
1907	do	34	696	1	1907	82,500.00	81,328.30	1,171.70
1907 and 1908	Mar. 4, 1907	34	1281	1	1907	25,000.00	14,188.10	10,811.90
Bureau of Plant Industry:								
General expenses	June 30, 1906	34	680	1	1907	480,406.28	470,158.84	8,801.16
Rent and repairs	do	34	681	1	1907	11,300.00	11,216.75	83.25
Ozark Mountain investigations	do	34	681	1	1907	3,553.72	4,993.44	6.56
Grain investigations	do	34	681	1	1907	15,000.00	14,903.23	96.77

[a] Of this amount $960,000 was paid directly to the experiment stations from the Treasury Department.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large. Vol.	Page.	Sec.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Bureau of Plant Industry—Continued.								
Improving roads	June 30, 1906	34	681	1	1907	$3,500.00	$3,474.10	$25.90
Purchase and distribution of valuable seeds	do	34	682	1	1907	205,140.00	201,004.98	4,135.02
Foreign seed and plant introduction	do	34	682	1	1907	35,781.21	33,834.64	1,946.57
Erection of building at Chico, Cal	do	34	683	1	1907	1,998.79	1,998.79	(*a*)
Cotton boll weevil investigations:								
1907	do	34	695	1	1907	105,000.00	101,832.47	3,167.53
1907 and 1908	Mar. 4, 1907	34	1280	1	1907	40,000.00	39,999.63	.37
Bureau of Chemistry:								
Laboratory	June 30, 1906	34	685	1	1907	145,920.00	142,174.00	3,746.00
Enforcement of the food and drugs act	Dec. 19, 1906	34	841	1	1907	250,000.00	100,279.95	149,720.05
Bureau of Soils:								
Soils investigations	June 30, 1906	34	687	1	1907	181,000.00	179,910.62	1,089.38
Rent of buildings	do	34	687	1	1907	4,000.00	3,920.00	80.00
Bureau of Entomology:								
Entomological investigations	do	34	688	1	1907	70,000.00	69,114.27	885.73
White fly investigations	do	34	688	1	1907	5,000.00	4,902.34	97.66
Cotton boll weevil investigations	do	34	695	1	1907	85,000.00	64,873.54	20,126.46
Preventing spread of moths:								
1907	do	34	696	1	1907	82,500.00	81,993.24	506.76
1907 and 1908	Mar. 4, 1907	34	1281	1	1907	150,000.00	8,592.73	141,407.27
Bureau of Biological Survey:								
Biological investigations	June 30, 1906	34	688	1	1907	44,420.00	43,975.22	444.78
Division of Publications:								
Publications, Farmers' Bulletins	do	34	690	1	1907	98,750.00	98,601.18	148.82
Artists, etc	do	34	690	1	1907	3,500.00	3,387.46	112.54
Labor, etc	do	34	690	1	1907	30,000.00	29,836.21	163.79
Bureau of Statistics:								
Collecting agricultural statistics	do	34	691	1	1907	108,000.00	105,466.40	2,533.60
Foreign markets investigations	do	34	691	1	1907	4,900.00	4,852.95	47.05
Office of Experiment Stations:								
Agricultural experiment stations ($803,500 [b])	do	34	693	1	1907	25,500.00	697,210.54	48,289.46
Farmers' institutes	do	34	693	1	1907	5,000.00	4,765.85	234.15
Station at Alaska, including $3,000 for purchase of live stock	do	34	693	1	1907	18,000.00	17,987.49	12.51
Station at Hawaii, including $5,000 for water supply	do	34	693	1	1907	20,000.00	19,998.75	1.25
Station at Porto Rico	do	34	693	1	1907	15,000.00	15,000.00	(*a*)
Nutrition investigations	do	34	694	1	1907	20,000.00	19,990.99	9.01
Irrigation investigations	do	34	694	1	1907	122,200.00	121,638.29	561.71
Office of Public Roads: Public road inquiries	do	34	694	1	1907	57,660.00	56,833.94	826.06
Weather Bureau:								
Salaries	do	34	671	1	1907	194,690.00	193,918.11	771.89
Fuel, lights, and repairs	do	34	671	1	1907	10,000.00	9,928.49	71.51
Contingent expenses	do	34	671	1	1907	10,000.00	9,912.56	87.44
Salaries, station employees	do	34	672	1	1907	541,550.00	540,702.30	847.70
General expenses	do	34	672	1	1907	630,000.00	616,415.03	13,584.97
Buildings	do	34	672	1	1907	53,000.00	51,727.28	1,272.72
Forest Service:								
Salaries, officers and clerks	June 30, 1906	34	683	1	1907	$112,860.00	$112,133.16	$726.84
General expenses	do	34	683	1	1907	849,640.00	849,265.94	374.06
Rent	do	34	685	1	1907	35,000.00	29,050.36	5,949.64
Building on Dismal River Forest Reserve	do	34	696	1	1907	2,500.00	2,475.22	24.78
Wichita Forest and Game Preserve	do	34	696	1	1907	15,000.00	14,999.00	1.00

[a] Exhausted.

[b] This includes $720,000 for state experiment stations paid through the Treasury Department. Congress also appropriated $336,000 for state experiment stations under the Adams bill to be paid through the Treasury Department. Total paid through the Treasury Department for state experiment stations, $1,056,000. Congress also appropriated in the sundry civil bill for printing and binding $300,000.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Forest Service—Continued.								
Survey and report on Appalachian and White Mountain watersheds, 1907 and 1908	Mar. 4, 1907	34	1281	1	1907	$25,000.00	$857.14	$24,142.86
Administration, etc., of the National Forests, 1907 and 1908	do	34	1270	1	1907	125,000.00	6,213.21	118,786.79
Special appropriations:								
Pomological investigations, fund from sale of fruits and vegetables	Apr. 23, 1904	33	382	1	1905	3,744.74	3,744.64	.10
Agricultural experiment stations, fund from sale of card indexes	do	33	293	1	1905	65.15	65.15	(*a*)
Buildings, Department of Agriculture	Mar. 3, 1903 Mar. 3, 1905	32 33	1139 1211			250,000.00 700,000.00		
Balance available July 1, 1906						480,934.68		
Sundry civil act	June 30, 1906	34	758			300,000.00	535,594.61	245,340.07
Administration, etc., forest reserves						925,000.00	812,293.34	112,706.66
Cooperative work, forest investigations						21,410.25	16,612.05	4,798.20
Salaries, officers and clerks	Mar. 4, 1907	34	1256	1	1908	825,890.00	771,881.43	54,008.57
Salaries, extra labor	do	34	1256	1	1908	7,600.00	7,184.94	415.06
Contingent expenses	do	34	1277	1	1908	47,000.00	39,860.67	7,139.33
Library	do	34	1277	1	1908	12,500.00	10,745.32	1,754.68
Bureau of Animal Industry:								
General expenses	do	34	1259	1	1908	892,200.00	774,562.84	117,637.16
Diseases of domestic animals, Minnesota	do	34	1259	1	1908	5,000.00	2,766.65	2,233.35
Animal breeding and feeding	do	34	1260	1	1908	50,000.00	46,840.81	3,159.19
Meat inspection	June 30, 1906	34	674	1	1908	3,000,000.00	2,481,539.40	518,460.60
Eradicating cattle ticks:								
1908	Mar. 4, 1907	34	1281	1	1908	125,000.00	112,282.59	12,717.41
1907 and 1908 (appropriated $25,000; balance July 1, 1907)	do	34	1281	1	1908	10,811.90	10,811.90	(*a*)
Bureau of Plant Industry:								
General expenses	do	34	1266	1	1908	573,480.00	500,282.55	73,197.45
Rent and repairs	do	34	1267	1	1908	11,300.00	8,830.75	2,469.25
Grain investigations	do	34	1267	1	1908	40,000.00	33,106.15	6,893.85
Purchase and distribution of valuable seeds (includes $50,000, deficiency act)	do	34	1267	1	1908	252,000.00	235,648.84	16,351.16
Foreign seed and plant introduction	do	34	1267	1	1908	36,000.00	26,006.49	9,993.51
Cotton boll weevil investigations:								
1908	do	34	1280	1	1908	110,000.00	95,607.35	14,392.65
1907 and 1908 (appropriated $40,000; balance July 1, 1907)	do	34	1280	1	1908	35,632.42	32,458.62	3,173.80
Bureau of Chemistry: Laboratory	do	34	1271	1	1908	650,000.00	467,654.99	182,345.01
Bureau of Soils:								
Soil investigations	do	34	1272	1	1908	166,000.00	146,905.64	19,094.36
Rent of buildings	do	34	1273	1	1908	4,000.00	3,156.66	843.34
Bureau of Entomology:								
Entomological investigations	do	34	1273	1	1908	103,800.00	90,923.05	12,876.95
White fly investigations	do	34	1274	1	1908	10,000.00	8,576.50	1,423.50
Cotton boll weevil investigations	do	34	1280	1	1908	40,000.00	34,592.99	5,407.01
Preventing spread of moths 1907 and 1908 (appropriated $150,000; balance July 1, 1907)	do	34	1280	1	1908	141,407.27	122,857.32	18,549.95
Bureau of Biological Survey: Biological investigations	do	34	1274	1	1908	44,420.00	39,629.92	4,790.08
Division of Publications: Publications[b]	do	34	1275	1	1908	35,000.00	32,889.67	2,110.33
Bureau of Statistics:								
Collecting agricultural statistics	do	34	1276	1	1908	118,000.00	96,344.56	21,655.44

[a] Exhausted.

[b] Congress also appropriated, in the sundry civil bill, for printing and binding $433,700.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Bureau of Statistics—Cont'd.								
Foreign markets investigations	Mar. 4, 1907	34	1276	1	1908	$4,900.00	$4,338.62	$561.38
Office of Experiment Stations:								
Agricultural experiment stations ($827,000) [a]	do	34	1278	1	1908	30,000.00	26,471.55	3,528.45
Farmers' institutes	do	34	1279	1	1908	5,000.00	4,348.68	651.32
Station at Alaska	do	34	1278	1	1908	24,000.00	24,000.00	(b)
Station at Hawaii	do	34	1278	1	1908	24,000.00	24,000.00	(b)
Station at Porto Rico	do	34	1278	1	1908	24,000.00	24,000.00	(b)
Nutrition investigations	do	34	1279	1	1908	5,000.00	1,593.00	3,407.00
Irrigation investigations	do	34	1279	1	1908	150,000.00	115,164.28	34,835.72
Office of Public Roads:								
Public road inquiries	do	34	1280	1	1908	55,660.00	48,930.52	6,729.48
Rent and repairs	do	34	1280	1	1908	2,000.00	1,723.27	276.73
Weather Bureau:								
Salaries	do	34	1257	1	1908	196,990.00	187,983.40	9,006.60
Fuel, lights, and repairs	do	34	1258	1	1908	10,000.00	7,143.66	2,856.34
Contingent expenses	do	34	1258	1	1908	10,000.00	8,032.53	1,967.47
Salaries, station employees	do	34	1258	1	1908	551,550.00	505,765.11	45,784.89
General expenses	do	34	1258	1	1908	645,000.00	411,441.43	233,558.57
Forest Service:								
Salaries, officers and clerks	do	34	1269	1	1908	143,200.00	130,031.93	13,168.07
General expenses	do	34	1269	1	1908	1,696,800.00	1,519,591.85	177,208.15
Rent (joint resolution, Jan. 7, 1908, increasing rent)	do	34	1270	1	1908	60,000.00	43,010.88	16,989.12
Administration, etc., of National Forests, 1908	do	34	1270	1	1908	375,000.00	291,353.63	83,646.37
Survey and report on Appalachian and White Mountain watersheds, 1907 and 1908 (appropriated $25,000; balance July 1, 1907)	do	34	1281	1	1908	23,403.76	15,272.33	8,131.43
Administration, etc., of National Forests, 1907 and 1908 (appropriated $125,000; balance July 1, 1907)	do	34	1270	1	1908	118,786.79	109,149.79	9,637.00
Special appropriations:								
Pomological investigations, fund from sale of fruits and vegetables, balance July 1, 1907	Apr. 23, 1904	33	382	1	......	1,779.40	1,011.28	768.12
Agricultural experiment stations, fund from sale of card indexes, balance July 1, 1907	Mar. 4, 1907	34	1278	1	......	65.15	65.15	(b)
Administration, etc., forest reserves ($2,401; 328.97, balance July 1, 1907)	....	....	......	...	......	1,172,922.36	988,318.93	184,603.43
Cooperative work, forest investigations	....	....	......	...	......	28,979.97	21,073.79	7,906.18
Buildings, Department of Agriculture ($1,250,000):								
Balance available July 1, 1907	Mar. 3, 1903	32	1139	...	......	245,340.07	465,045.74	30,294.33
Sundry civil act, Mar. 4, 1907	Mar. 3, 1905	33	1211	...	......	250,000.00		
Salaries, officers and clerks	May 23, 1908	35	251	1	1909	879,660.00	857,714.32	21,945.68
Salaries, extra labor	do	35	251	1	1909	7,600.00	7,410.85	189.15
Contingent expenses	do	35	265	1	1909	86,200.00	79,017.79	7,182.21
Library	do	35	264	1	1909	15,500.00	11,535.83	3,964.17
Bureau of Animal Industry:								
General expenses	do Feb. 9, 1909 Mar. 4, 1909	35 35 35	254 616 927	1 1 1	1909	[c]1,247,200.00	1,164,186.71	83,013.29
Animal breeding and feeding	May 23, 1908	35	255	1	1909	50,000.00	44,817.57	5,182.43
Meat inspection	June 30, 1906	34	674	1	1909	3,000,000.00	2,848,818.38	151,181.62
Eradicating cattle ticks:								
1909	May 23, 1908	35	268	1	1909	225,000.00	192,528.67	32,471.33
1908 and 1909	do	35	268	1	1909	25,000.00	25,000.00	(b)

[a] This includes $720,000 for state experiment stations under the regular appropriation, to be paid through the Treasury Department. Congress also appropriated $432,000 as a permanent appropriation for state experiment stations under the Adams bill, to be paid through the Treasury Department. Total to be paid through the Treasury Department for state experiment stations, $1,152,000.

[b] Exhausted.

[c] Including $150,000, deficiency act, February 9, 1909, and $150,000 by deficiency act, March 4, 1909.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

Purpose.	Date of appropriation act.	Reference to Statutes at Large.			Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
		Vol.	Page.	Sec.				
Bureau of Plant Industry:								
General expenses:								
1909	May 23, 1908	35	256	1	1909	$886,266.00	$810,846.00	$75,420.00
1908 and 1909	do	35	256	1	1909	10,000.00	8,589.32	1,410.68
Purchase and distribution of valuable seeds $205,000 Foreign seed and plant introduction $53,000	do	35	257	1	1909	258,000.00	194,020.57 45,492.56	10,979.43 7,507.44
Paper tests	do	35	267	1		10,000.00	7,472.52	2,527.48
General expenses, 1909 and 1910	Mar. 4, 1909	35	1,044	1	1909	50,000.00	17,366.47	32,633.53
Bureau of Chemistry: Laboratory	May 23, 1908 Feb. 9, 1909	35 35	260 616	1 1	1909	[a] 860,000.00	612,495.42	247,504.58
Bureau of Soils: Soil investigations	May 23, 1908	35	261	1	1909	200,000.00	190,224.94	9,775.06
Bureau of Entomology:								
Entomological investigations:								
1909	do	35	262	1	1909	148,800.00	139,380.22	9,419.78
1908 and 1909	do	35	262	1	1909	10,000.00	9,451.81	548.19
Preventing spread of moths, 1908 and 1909	do	35	268	1	1909	250,000.00	217,569.44	32,430.56
Bureau of Biological Survey:								
Biological investigations	do	35	262	1	1909	54,420.00	51,117.29	3,302.71
Division of Publications: Publications, Department of Agriculture[b]	do	35	263	1	1909	40,000.00	38,867.69	1,132.31
Bureau of Statistics: Collecting agricultural statistics	do	35	264	1	1909	125,000.00	114,028.11	10,971.89
Office of Experiment Stations:								
Agricultural experiment stations ($843,000)[c]	do	35	265	1	1909	30,000.00	28,518.46	1,481.54
Farmers' institutes	do	35	266	1	1909	10,000.00	8,359.83	1,640.17
Station at Alaska	do	35	266	1	1909	26,000.00	26,000.00	(*d*)
Station at Hawaii	do	35	266	1	1909	26,000.00	26,000.00	(*d*)
Station at Porto Rico	do	35	266	1	1909	26,000.00	26,000.00	(*d*)
Station at Island of Guam	do	35	266	1	1909	5,000.00	5,000.00	(*d*)
Nutrition investigations	do	35	266	1	1909	7,000.00	6,993.53	6.47
Irrigation investigations	do	35	266	1	1909	150,000.00	143,465.23	6,534.77
Office of Public Roads:								
Public roads inquiries	do	35	267	1	1909	73,000.00	67,828.09	5,171.91
Rent and repairs	do	35	267	1	1909	2,000.00	1,833.33	166.67
Weather Bureau:								
Salaries	do	35	252	1	1909	202,510.00	202,142.73	367.27
Fuel, lights, and repairs	do	35	252	1	1909	10,000.00	8,266.67	1,733.33
Contingent expenses	do	35	253	1	1909	11,000.00	9,964.55	1,035.45
Salaries, station employees	do	35	253	1	1909	586,750.00	585,564.89	1,185.11
General expenses	do	35	253	1	1909	852,000.00	496,107.93	355,892.07
Forest Service:								
Salaries, officers and clerks	do	35	258	1	1909	144,300.00	143,464.87	835.13
General expenses	do	35	259	1	1909	3,151,900.00	2,821,162.56	330,737.44
Improvement of the national forests	do	35	260	1	1909	600,000.00	501,903.96	98,096.04
Naval stores industry	do	35	267	1	1909	10,000.00	8,949.32	1,050.68
National Bison Range	do Mar. 4, 1909	35 35	267 927	1 1	1909	[e] 43,000.00	219.60	42,780.40
Special appropriations:								
Pomological investigations, fund from sale of fruits and vegetables, balance July 1, 1908	Apr. 23, 1904	33	382	1		768.12	768.02	.10
Buildings, Department of Agriculture ($1,500,000):								
Balance available on July 1, 1908	Mar. 4, 1907	34	1,364	1		30,294.33	29,043.23	1,251.10
Cooperative work, forest investigations						45,978.88	26,687.63	19,291.25
Refunds to depositors, excess of deposits						54,172.86	40,098.73	14,074.13

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[a] Including $100,000, deficiency act, February 9, 1909.

[b] Congress also appropriated in the sundry civil bill for printing and binding, $460,000.

[c] This includes $720,000 for state experiment stations under the regular appropriation, to be paid through the Treasury Department. Congress also appropriated $528,000 as a permanent appropriation for state experiment stations under the Adams bill, to be paid through the Treasury Department. Total to be paid through the Treasury Department for state experiment stations, $1,248,000.

[d] Exhausted.

[e] Including $3,000, deficiency act, March 4, 1909.

Statement of appropriations, disbursements, and unexpended balances for the United States Department of Agriculture, etc.—Continued.

RECAPITULATION.

Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
1839...	$1,000.00	$1,000.00	....	1876..	$249,120.00	$198,843.64	$50,276.36
1840...	....	....	....	1877..	194,686.96	188,206.19	6,480.77
1841...	....	....	....	1878..	198,640.00	197,634.94	1,005.06
1842...	1,000.00	1,000.00	....	1879..	206,400.00	206,360.00	40.00
1843...	....	....	....	1880..	199,500.00	198,361.72	1,138.28
1844...	2,000.00	2,000.00	....	1881..	275,460.31	267,608.84	[b] 7,851.47
1845...	2,000.00	2,000.00	....	1882..	363,011.05	354,482.39	[c] 8,528.66
1846...	3,000.00	3,000.00	....	1883..	456,396.11	438,941.72	[d] 17,454.39
1847...	3,000.00	3,000.00	....	1884..	[a] 416,641.13	413,618.09	3,023.04
1848...	4,500.00	4,500.00	....	1885..	[a] 655,930.25	558,934.89	[e] 96,995.36
1849...	3,500.00	3,500.00	....	1886..	[a] 677,973.22	519,196.11	158,777.11
1850...	5,500.00	5,500.00	....	1887..	[a] 657,641.81	628,287.14	29,354.67
1851...	5,500.00	5,500.00	....	1888 [f]	1,027,219.06	1,011,282.62	15,936.44
1852...	5,000.00	5,000.00	....	1899..	[a] 1,134,480.60	1,033,590.22	[g] 100,890.38
1853...	5,000.00	5,000.00	....	1890..	[a] 1,170,139.11	971,823.62	[h] 198,315.49
1854...	10,000.00	10,000.00	....	1891..	[a] 1,372,049.21	1,266,277.36	105,771.85
1855...	[a] 50,000.00	50,000.00	....	1892..	[a] 2,303,655.75	2,253,262.29	50.393.46
1856...	30,000.00	30,000.00	....	1893..	2,540,060.72	2,355,430.25	184.630.47
1857...	75,000.00	75,000.00	....	1894..	2,603,855.58	1,977,469.28	[i] 626,386.30
1858...	63,500.00	63,157.25	$342.75	1895..	[i] 2,506,915.00	2,021,030.38	485,884.62
1859...	60,000.00	60,000.00	....	1896..	2,584,013.22	2,094,916.42	489,096.80
1860...	40,000.00	40,000.00	....	1897..	2,448,763.53	2,348,512.98	100,250.55
1861...	60,000.00	60,000.00	....	1898..	2,467,902.00	2,425,510.44	42,391.56
1862...	64,000.00	63,704.21	295.79	1899..	2,829,702.00	2,827,795.65	28,899.27
1863...	80,000.00	80,000.00	....	1900..	3,006,022.00	2,947,603.42	58,418.58
1864...	199,770.00	189,270.00	10,500.00	1901..	3,304,265.97	3,239,137.39	65,128.58
1865...	112,304.05	112,196.55	107.50	1902..	3,922,780.51	3,902,675.79	20,104.72
1866...	167,787.82	167,787.82	....	1903..	5,015,846.00	4,734,230.84	281,615.16
1867...	199,100.00	199,100.00	....	1904..	5,025,024.01	4,969,311.64	55,712.37
1868...	279,020.00	277,094.34	1,925.66	1905..	5,894,540.00	5,820,204.00	74,336.00
1869...	172,593.00	172,593.00	....	1906..	6,225,690.00	6,029,510.02	196,179.98
1870...	156,440.00	151,596.93	4,843.07	1907..	9,505,484.74	9,025,318.93	1,200,165.81
1871...	[a] 188,180.00	186,876.81	1,303.19	1908 [j]	13,201,419.09	11,212,809.95	1,988,609.14
1872...	197,070.00	195,977.25	1,092.75	1909 [j]	14,536,320.19	12,902,295.64	1,634,024.55
1873...	202,440.00	201,321.22	1,118.78				
1874...	257,690.00	233,765.78	23,924.22	Total	[k] 101,531,615.50	[l] 93,218,807.25	[m] 9,118,579.00
1875...	337,380.00	321,079.83	16,300.17				

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[a] Including deficiency appropriation.

[b] Includes $1,646.45 of the appropriation for reclamation of arid lands, carried to the fiscal year 1882.

[c] Includes $85.26 of the appropriation for reclamation of arid lands and $3,530.85 of the appropriation for experiments in the manufacture of sugar, carried to the fiscal year 1883.

[d] Includes $7,656.13 of the appropriation for reclamation of arid lands, carried to the fiscal year 1884.

[e] Includes $93,192.27 of the appropriation for Bureau of Animal Industry and $2,970.82 of the appropriation for quarantine stations, carried to the fiscal year 1886.

[f] For the fiscal year 1888, including the sum of $8,000 appropriated for deficiencies in the appropriation for experiments in the manufacture of sugar for the fiscal years 1887 and 1888, of which $7,927.50 was disbursed and $72.50 remained unexpended.

[g] Includes $12,923.25 of the appropriation for botanical investigations and $58,364.76 of the appropriation for experiments in the manufacture of sugar, carried to the fiscal year 1890.

[h] Includes $188,974.69 of the appropriation for Bureau of Animal Industry, carried to the fiscal year 1891.

[i] Includes $7,891.94 for statutory salaries of the year 1894.

[j] For the years 1908 and 1909 the figures given represent payments made to close of June 30, 1909, the accounts for those years being still open at the date of this revision.

[k] This total is the amount actually appropriated for the various fiscal years, with the exception of $37,604.70 appropriated July 13, 1868, to cover a number of expenditures made in previous years. It does not include an aggregate sum of $369,344.48 reappropriated from the unexpended balances of several fiscal years. (See foregoing notes.)

[l] Does not include $37,604.70 which was disbursed during several years, and covered by an appropriation of like amount, made July 13, 1868. (See note *k*.)

[m] Does not include an aggregate sum of $369,344.48 reappropriated from the unexpended balances of several fiscal years. (See foregoing notes.)

REPORT OF THE EDITOR.

U. S. Department of Agriculture,
Division of Publications,
Washington, D. C., September 1, 1909.

Sir: I have the honor to submit herewith a report of the operations of the Division of Publications for the fiscal year ended June 30, 1909, some references to the work in contemplation for 1910, and a few recommendations in regard to the year 1911.

Respectfully,

Jos. A. Arnold,
Editor and Chief.

Hon. James Wilson,
Secretary of Agriculture.

WORK OF THE YEAR.

SUMMARY OF RESULTS.

If this Department's success may be measured by the volume of reading matter which it prints and distributes, the past year has been the most successful in its career. An increase in the publication work is the natural and inevitable accompaniment of the Department's growth and extension, since it is mainly through the printed page that its work becomes practically effective. That the increase in publications is less rapid than the corresponding growth of the Department may be credited in large part to the economies effected in the administration of its printing fund.

During the year 1909, 1,200 separate publications were issued. Of these, 1,135 were issued by the Department through this Division, and 65 were issued through the Weather Bureau, all of the latter being new. Of the total number, 715 were new and 485 were reissues of earlier publications. Of the Department publications issued through this Division, 650 were new and 485 were reissues of earlier publications, 271 were Farmers' Bulletins, and 864 were miscellaneous publications—reports, bulletins, circulars, separates, etc. Of the miscellaneous publications, 614 were new and 250 were earlier publications reissued. Of the Farmers' Bulletins, 36 were new and 235 were reprints.

Of all publications, a total of 17,190,345 copies were printed, of which 16,556,950 were issued through this Division, and 633,395 were copies of Weather Bureau publications. Of the total copies, 10,022,995 were of new publications, and 7,167,350 were of earlier issues reprinted. There were 8,801,950 copies of miscellaneous publications issued through this Division and 7,755,000 copies of Farmers' Bulletins. Of the miscellaneous, 8,094,600 copies were new and 707,350 were reprints. Of the Farmers' Bulletins, 1,295,000 copies were of new issues and 6,460,000 were of earlier bulletins.

The publications issued contained a total of 42,263 printed pages, of which 2,116 represented Weather Bureau publications, and 40,147 publications passing through this Division; 27,581 pages represented new publications, and 14,682 reprints of earlier publications. The miscellaneous publications issued through this Division contained 31,689 pages, 24,337 being in new issues and 7,352 in the earlier publications which were reprinted. The new Farmers' Bulletins contained 1,128 pages, and the earlier bulletins reissued comprised 7,330 pages.

In the accompanying table appears a complete statement of the publications issued by the Department, exclusive of the Weather Bureau. It shows separately the new publications of the year and the earlier publications reprinted, with the number of publications, the number of printed pages, and the number of copies in each class, and the last three columns contain the totals for both classes. The table also shows separately the Farmers' Bulletins and the other publications, with the totals for the two classes combined.

Publications issued by the Department (exclusive of the Weather Bureau) during the fiscal year 1909, classified according to the Bureau, Division, or Office contributing them.

ALL PUBLICATIONS EXCEPT FARMERS' BULLETINS.

Bureau, Division, or Office contributing publications.	New or newly revised.			Earlier issues reprinted.			Totals.		
	No.	Pages.	Copies.[a]	No	Pages.	Copies.[a]	No.	Pages.	Copies.[a]
Secretary's Office:									
Departmental	61	1,460	698,200	21	103	120,000	82	1,563	818,200
Congressional	56	7,034	95,100	....	....	....	56	7,034	95,100
Accounts	1	40	200	....	....	....	1	40	200
Animal Industry	58	1,549	259,350	29	696	84,000	87	2,245	343,350
Biological Survey	18	1,064	68,800	13	458	34,000	31	1,522	102,800
Chemistry	38	2,340	72,650	11	813	10,000	49	3,153	82,650
Entomology	46	888	175,700	31	615	72,500	77	1,503	248,200
Experiment Stations	80	3,506	340,000	32	1,687	29,400	112	5,193	369,400
Forest Service	89	1,600	848,100	59	1,349	122,750	148	2,949	970,850
Library	5	244	4,300	....	....	....	5	244	4,300
Plant Industry	85	2,114	708,300	28	761	192,700	113	2,875	901,000
Publications	36	915	2,957,200	....	....	....	36	915	2,957,200
Public Roads	7	231	31,300	4	66	10,700	11	297	42,000
Soils	8	548	21,300	20	689	30,100	28	1,237	51,400
Statistics	24	760	1,810,100	2	115	1,200	26	875	1,811,300
Weather Bureau[b]	2	44	4,000	....	....	....	2	44	4,000
Total	614	24,337	8,094,600	250	7,352	707,350	864	31,689	8,801,950

[a] The number of copies given here is in all cases the number ordered printed. The number of copies received from the Government Printing Office frequently overruns the number ordered; and sometimes on large editions the overrun amounts to several hundred copies. Hence the total copies received during the year was a little larger than is shown here.

[b] These publications, though contributed by the Weather Bureau, were issued by the Department through the Division of Publications.

Publications issued by the Department (exclusive of the Weather Bureau) during the fiscal year 1909, etc.—Continued.

FARMERS' BULLETINS.

Bureau, Division, or Office contributing publications.	New or newly revised.			Earlier issues reprinted.			Totals.		
	No.	Pages.	Copies.[a]	No.	Pages.	Copies.[a]	No.	Pages.	Copies.[a]
Animal Industry	8	218	255,000	25	861	1,080,000	33	1,079	1,335,000
Biological Survey	5	153	140,000	3	86	60,000	8	239	200,000
Chemistry	2	63	110,000	4	129	70,000	6	192	180,000
Entomology	1	48	70,000	20	528	285,000	21	576	355,000
Experiment Stations	6	188	200,000	79	2,693	1,980,000	85	2,881	2,180,000
Forest Service	3	102	65,000	4	177	165,000	7	279	230,000
Plant Industry	10	317	405,000	84	2,370	2,290,000	94	2,687	2,695,000
Publications				5	190	155,000	5	190	155,000
Public Roads	1	39	50,000	4	100	220,000	5	139	270,000
Soils				6	165	140,000	6	165	140,000
Weather Bureau[b]				1	31	15,000	1	31	15,000
Total	36	1,128	1,295,000	235	7,330	6,460,000	271	8,458	7,755,000

ALL PUBLICATIONS, INCLUDING FARMERS' BULLETINS.

Secretary's office:									
Departmental	61	1,460	698,200	21	103	120,000	82	1,563	818,200
Congressional	56	7,034	95,100				56	7,034	95,100
Accounts	1	40	200				1	40	200
Animal Industry	66	1,767	514,350	54	1,557	1,164,000	120	3,324	1,678,350
Biological Survey	23	1,217	208,800	16	544	94,000	39	1,761	302,800
Chemistry	40	2,403	182,650	15	942	80,000	55	3,345	262,650
Entomology	47	936	245,700	51	1,143	357,500	98	2,079	603,200
Experiment Stations	86	3,694	540,000	112	4,380	2,009,400	198	8,074	2,549,400
Forest Service	92	1,702	913,100	63	1,526	287,750	155	3,164	1,200,850
Library	5	244	4,300				5	244	4,300
Plant Industry	94	2,431	1,113,300	112	3,131	2,482,700	206	5,562	3,611,000
Publications	36	915	2,957,200	5	190	155,000	41	1,105	3,112,200
Public Roads	8	270	81,300	8	166	230,700	16	436	312,000
Soils	8	548	21,300	26	854	170,100	34	1,402	191,400
Statistics	24	760	1,810,100	2	115	1,200	26	875	1,811,300
Weather Bureau[b]	2	44	4,000	1	31	15,000	3	75	19,000
Total	650	25,465	9,389,600	485	14,682	7,167,350	1,135	40,147	16,556,950

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[a] The number of copies given here is in all cases the number ordered printed. The number of copies received from the Government Printing Office frequently overruns the number ordered; and sometimes on large editions the overruns amounts to several hundred copies. Hence the total copies received during the year was a little larger than is shown here.

[b] These publications, though contributed by the Weather Bureau, were issued by the Department through the Division of Publications.

The following table shows the principal new publications issued from the Washington office of the Weather Bureau during the fiscal year:

Principal new publications issued by the Weather Bureau during the fiscal year 1909.

Class of publications.	Number.	Pages.	Copies.
Bulletins	5	693	5,600
Circular	1	110	1,000
Report on Daily River Stages, Part VIII	1	270	500
Administrative publications	2	154	4,000
Washington Daily Weather Map	1	365	474,055
Monthly Weather Review	12	481	57,600
National Weather Bulletins	27	27	69,190
Snow and Ice Charts	16	16	21,450
Total	65	2,116	633,395

The Department's total volume of publication work during the fiscal year, found by combining the totals of the foregoing tables, was as follows:

Publications issued by the Department, including the Weather Bureau, during the fiscal year ended June 30, 1909.

	New or newly revised.			Earlier publications reprinted.			Totals.		
	Number.	Pages.	Copies.	Number.	Pages.	Copies.	Number.	Pages.	Copies.
Departmental:									
Miscellaneous	614	24,337	8,094,600	250	7,352	707,350	864	31,689	8,801,950
Farmers' Bulletins	36	1,128	1,295,000	235	7,330	6,460,000	271	8,458	7,755,000
Total	650	25,465	9,389,600	485	14,682	7,167,350	1,135	40,147	16,556,950
Weather Bureau	65	2,116	633,395				65	2,116	633,395
Grand total	715	27,581	10,022,995	485	14,682	7,167,350	1,200	42,263	17,190,345

For a number of years past the publications have been reported as originals and reprints, each reprinted edition being counted as a publication. This year they have been classified as (1) new publications of the year and (2) earlier publications reissued, each publication being counted but once, no matter how often reprinted. Parts of publications issued in separate form are, however, considered publications, as heretofore. It is believed that in the new form these statistics present the facts more accurately and at the same time clearly show the preponderance of new work. By another change a number of minor publications heretofore omitted from the list have been included; also a considerable class which has been denominated "administrative" publications, since they contain instructions and information for Department employees rather than for the general public. "Regulations Governing the Meat Inspection" and "Service Announcements" of the Bureau of Animal Industry, and "Manual of Procedure" of the Forest Service may be cited as examples of this class. Since all these publications are in the nature of reading matter and are issued in large editions, their inclusion is believed to be absolutely necessary to a fair and full presentation of the Department's publication work.

These changes interfere somewhat with comparisons between the work of the year and that of previous years. The following table has, however, been compiled with a view to comparing the output of printed matter during the past three years. It should be noted that the number of editions issued is equivalent to the total number of originals and reprints under the old classification.

Output of publications from the Department for the fiscal years 1907, 1908, and 1909 compared.

	1907.	1908.	1909.
Number of editions issued	1,415	1,522	1,758
Number of copies	16,749,610	16,875,515	17,190,345

WEATHER BUREAU PUBLICATIONS.

Of the funds appropriated for the Department's printing and binding, Congress allots a specific sum for the publications of the Weather Bureau. These publications do not pass through this Division as do other publications of the Department. They are printed either at the Weather Bureau or the Government Printing Office, are handled and stored at the Bureau, and distributed therefrom.

The foregoing table of Weather Bureau publications and the list appearing on page 653 contain the important regular publications prepared and issued at the main office of the Weather Bureau in Washington, D. C. But these statistics are incomplete, in that they omit a number of valuable separates, some small circulars, and several important charts issued during the year, and contain no record of the publications issued from Weather Bureau offices outside of Washington.

Ocean charts.—The Bureau during last year began the issue of meteorological charts of the oceans. A chart for the North Atlantic is issued monthly in editions of about 5,000 copies; one for the North Pacific, monthly, in editions of about 2,500; one for the South Atlantic, quarterly, in editions of 2,000; and one for the South Pacific, quarterly, in editions of 1,500. These charts are 21 by 28 inches in size and are printed in colors.

Weather maps and bulletins.—In addition to the publications issued from the Washington office of the Weather Bureau, there is an immense output of Weather Maps, Weather Bulletins, and Climatological Reports issued at the Weather Bureau stations located in all parts of the United States. Weather maps with tabulated data, local forecasts, and descriptive matter are issued daily (except Sundays and holidays) at 112 stations. These maps are on sheets 11 by 16 inches in size. At 33 of these stations they are printed from type, and at 79 stations they are run off by a duplicating process. About 34,000 separate issues of these maps were printed and distributed during the year in editions ranging from 100 to 2,000 copies, the grand aggregate of copies issued during the year being 10,500,000. The subscription price of these local Weather Maps is 20 cents per month, or $2 a year. Twelve less important stations issue daily bulletins with data and forecasts but without maps, the aggregate copies issued during the past year being 125,000. In addition to these, Cotton-Region Bulletins and Corn-and-Wheat-Region Bulletins are issued in large numbers.

Climatological reports.—During the past fiscal year each of 44 section centers of the Weather Bureau issued Climatological Reports monthly, with an Annual Summary, making 13 numbers of 8 quarto pages in each case. The total number of issues of these reports was 572 and the total number of copies 23,629. The publication of these reports ceased with the close of the year.

FARMERS' BULLETINS.

It is now twenty years since the first Farmers' Bulletin was issued. The need for brief, inexpensive publications, which should convey useful information to practical people in plain, every-day English, led to the printing of the first Farmers' Bulletin in June, 1889. The same need has led to the enormous growth of the series, until at the end of June, 1909, 361 different bulletins had been issued and over 69,000,000 copies had been printed and distributed. At first the growth of the series was comparatively slow. At the end of five years but 17 bulletins had been issued and less than a million copies printed. At this time Congress awoke to a realizing sense of the value of these bulletins, provided quotas for distribution by its members, and the series began to grow in earnest. By July 1, 1899, at the end of another five years, Farmers' Bulletin No. 100 had been issued and more than 11,000,000 copies had been printed and distributed. In 1904, at the end of another five years, Bulletin 202 had been issued and the grand total of copies had passed the 36,000,000 mark. During the past five years 159 new bulletins have been added to the series and 33,000,000 copies have been printed and put into circulation.

The Farmers' Bulletins differ in some important particulars from other classes of Department publications. Though prepared in the different branches of the Department, they belong to no Bureau, Office, or Division, but rather to the Department as a whole. A distinct appropriation is made for their publication. They are issued in inexpensive form, are distinctly popular and severely practical in character, are issued in large editions, are for free general distribution, and are continually reprinted to supply the demand for copies. They cover an extremely wide range of subjects, and whenever a bulletin becomes out of date, it is either revised or replaced by a new one covering the same ground. Many of the earlier issues are still reprinted and distributed in large numbers.

The following table shows the growth of the Farmers' Bulletin series during the past twenty years, together with the growth and extent of the congressional distribution:

Growth of the Farmers' Bulletin series during twenty years, with congressional distribution.

Year.	New bulletins issued.	Copies issued.	Copies distributed by Congressmen.	Year.	New bulletins issued.	Copies issued.	Copies distributed by Congressmen.
1890–1893	12	540,000	....	1903	22	6,602,000	3,954,976
1894	5	278,500	....	1904	25	6,435,000	4,895,556
1895	11	1,567,000	885,770	1905	24	5,925,500	4,782,643
1896	13	1,891,000	1,316,695	1906	33	6,568,000	5,279,476
1897	16	2,387,000	1,967,237	1907	42	6,469,000	3,484,713
1898	21	2,170,000	1,580,065	1908	26	6,574,500	3,928,437
1899	22	2,437,000	1,101,985	1909	34	7,755,000	3,960,642
1900	18	2,360,000	1,666,909				
1901	14	3,345,000	2,195,010	Total	361	69,454,500	35,289,240
1902	23	6,150,000	4,289,126				

During the year 34 new Farmers' Bulletins were issued and 2 of the earlier bulletins were revised. The following is a list of these bulletins, with the number of copies printed:

New or newly revised Farmers' Bulletins issued during the fiscal year 1909.

No. of bulletin.	Title of bulletin.	Total number of copies.
52	The Sugar Beet (Third revision)	20,000
137	The Angora Goat (Revised)	15,000
328	Silver Fox Farming	20,000
329	Experiment Station Work—XLVII	30,000
330	Deer Farming in the United States	25,000
331	Forage Crops for Hogs in Kansas and Oklahoma	35,000
332	Nuts and Their Uses as Food	40,000
333	Cotton Wilt	25,000
334	Experiment Station Work—XLVIII	40,000
335	Harmful and Beneficial Mammals of the Arid Interior	20,000
336	Game Laws for 1908	40,000
337	Cropping Systems for New England Dairy Farms	30,000
338	Macadam Roads	50,000
339	Alfalfa	105,000
340	Declaration of Governors for Conservation of Natural Resources	20,000
341	The Basket Willow	20,000
342	Experiment Station Work—XLIX	45,000
343	The Cultivation of Tobacco in Kentucky and Tennessee	45,000
344	The Boll Weevil Problem with Special Reference to Means of Reducing Damage	70,000
345	Some Common Disinfectants	25,000
346	The Computation of Rations for Farm Animals by the Use of Energy Values	35,000
347	The Repair of Farm Equipment	45,000
348	Bacteria in Milk	40,000
349	The Dairy Industry in the South	40,000
350	The Dehorning of Cattle	35,000
351	The Tuberculin Test of Cattle for Tuberculosis	30,000
352	The Nevada Mouse Plague of 1907–8	35,000
353	Experiment Station Work—L	30,000
354	Onion Culture	45,000
355	A Successful Poultry and Dairy Farm	45,000
356	Peanuts	20,000
357	Methods of Poultry Management at the Maine Agricultural Experiment Station	15,000
358	A Primer of Forestry. Part II: Practical Forestry	25,000
359	Canning Vegetables in the Home	90,000
360	Experiment Station Work—LI	15,000
361	Meadow Fescue: Its Culture and Uses	10,000
	Total (36 bulletins)	1,295,000

The table following shows the output of Farmers' Bulletins during the past three years and the expenditures therefor:

Output of Farmers' Bulletins and the cost for the fiscal years 1907, 1908, and 1909.

Fiscal year.	Fund drawn upon.	Number of bulletins.	Number of copies.	Cost.
1907	Farmers' Bulletin fund	235	6,469,000	$98,601.17
1908	do	252	6,574,500	98,601.49
1909	do	271	7,755,000	122,475.48

The appropriation for printing Farmers' Bulletins for the fiscal year 1909 was $125,000, of which $122,475.48 was expended. The cost per copy for the year was a little less than 1⅗ cents. The cost during 1907 and 1908 was a trifle over 1½ cents.

The records show that 7,774,248 copies of Farmers' Bulletins were received from the Government Printing Office, or 19,648 more than the total number ordered (see footnote on page 592). These, with the

1,298,474 copies on hand at the beginning of the year, made a total of 9,073,122 copies. Of these, 2,870,359 copies were sent out in response to miscellaneous requests and 3,962,642 were distributed on the order of Senators, Representatives, and Delegates in Congress, leaving 2,242,121 copies on hand to complete the Congressional quotas.

Prior to 1908, the appropriation act allotting funds for the printing of Farmers' Bulletins provided that the uncalled-for quotas of Congressmen should revert to the Secretary of Agriculture, and under this provision he used them in making up new quotas for the succeeding Congress or in the Department's miscellaneous distribution of its quota of one-fifth of those printed. From the more recent appropriation acts this provision has been omitted. Its inclusion in future appropriation acts seems desirable, as otherwise a considerable number of quotas remain uncalled for in whole or in part, which leads to congestion of the Department's limited storage space, and at the same time keeps this useful reading matter out of the hands of persons who need it and are asking for it.

That the popularity of Farmers' Bulletins is steadily increasing is proven by the facts and figures given in this report. As further proof, attention may be directed to the sale by the Superintendent of Documents during the fiscal year of 27,483 copies of Farmers' Bulletins at 5 cents per copy.

The demand for these publications is far in excess of our ability to supply them. Requests are received not only from farmers but from educational institutions, where they are desired for use as textbooks or reference works, and it is to be regretted that requests from this source can not be fully complied with, and applicants are of necessity referred to Senators and Representatives in Congress and to the Superintendent of Documents when large numbers are desired.

SALE OF PUBLICATIONS OF THE DEPARTMENT.

The sentiment in favor of the sale of Government publications is increasing each year, as shown by the willingness of applicants to pay the nominal charge affixed by the Superintendent of Documents under the law of January 12, 1895. The sales of documents of this Department by that official during the year amounted to $16,293.10, the number of copies sold being 117,218. These represented more than 3,600 different publications. The average price per copy was nearly 14 cents. The publications sold cover the work of the Department during the past forty-six years, ranging from an Annual Report for 1863 to bulletins of most recent date. In size these publications ranged from a one-page leaflet to bound volumes of more than 1,300 pages. In price per copy they ranged from 5 cents for circulars and small bulletins to $6.35 for Field Operations of the Bureau of Soils for 1903 and $10 for Bulletin Q of the Weather Bureau. The greatest number of copies of any Bureau bulletin sold was 2,403 of Chemistry Bulletin 107 on Official Methods of Analysis. The greatest number sold of any circular was 5,031 copies of Forest Service Circular 141 on Wood Paving in the United States. The largest income from any single publication was $1,103.70 for the Special Report on Diseases of the Horse, of which 1,698 copies were sold at 65 cents each.

The enormous increase in the sales of the Department's publications within recent years is shown in the following table:

Sales of agricultural publications by the Superintendent of Documents during fiscal years 1906–1909.

	1906.	1907.	1908.	1909.
Number of copies	47,745	71,764	94,926	117,218
Amount received	$5,388.28	$10,885.20	$14,174.22	$16,293.10

It will be observed that within four years the number of copies sold has increased over 145 per cent, while the amount received has increased more than 200 per cent.

No other Government publishes as many public documents as the United States, and no other Executive Department of the Government issues as many publications as the Department of Agriculture. It is the function of this Department to acquire and disseminate useful information in regard to agriculture. With the rapid increase in population of the country and the consequent increasing demand for publications it became apparent many years ago that the Department could probably never secure an appropriation sufficient for printing enough documents to supply the demand. Congress has, however, provided a solution of the problem by authorizing the sale of Government publications at a nominal price. Under the operation of a provision of the law the Superintendent of Documents can reprint and sell any publication so long as there is a demand for it without any expense to this Department. Consequently, by paying the price affixed by law applicants are able to secure documents which can no longer be obtained from the Department and which would not otherwise be available owing to the insufficiency of the Department's fund for printing additional copies. It has become necessary, therefore, to adopt the policy of referring miscellaneous applicants for scientific or technical publications to the Superintendent of Documents when the limited editions of the Department are exhausted and it is not possible to order additional copies.

In 1906 the Superintendent of Documents reprinted 43 publications of this Department, the total number of copies issued being a little more than 10,000. During the past year he reprinted 155 different publications, issuing a total of 44,354 copies, an increase in four years of more than 300 per cent.

The character of the publications of this Department reissued by the Superintendent of Documents is shown by the following table:

Classes of agricultural publications reissued by the Superintendent of Documents during the fiscal year 1909.

Class of publications.	Number.	Copies.
Bulletins	128	33,704
Circulars	2	5,250
Reports	2	600
Experiment station records	17	1,700
Farmers' bulletins	6	3,100
Total	155	44,354

The following table shows the agricultural publications reissued by the Superintendent of Documents, classified according to the main branch of the Department which originally contributed them:

Agricultural publications reissued by the Superintendent of Documents during 1909, classified according to the Bureau or Office originally contributing them.

Bureau or Office.	Number.	Copies.
Office of the Secretary	2	600
Bureau of Animal Industry	14	3,530
Biological Survey	3	853
Bureau of Chemistry	26	7,449
Bureau of Entomology	14	3,405
Office of Experiment Stations	39	7,287
Forest Service	11	9,020
Bureau of Plant Industry	29	7,240
Office of Public Roads	5	2,414
Bureau of Soils	9	1,956
Bureau of Statistics	1	100
Weather Bureau	2	500
Total	155	44,354

Under the law of January 12, 1895, all remittances for publications should be forwarded to the Superintendent of Documents, Government Printing Office. By instructions conspicuously printed at the head of the Monthly List of Publications correspondents are advised to apply to that official when they desire to obtain any publication to which a price is affixed. Notwithstanding all effort to prevent it, however, money in payment for publications continues to come to this Division, the amount received during the fiscal year being $1,254.65, all of which had to be forwarded to the Superintendent of Documents by registered mail. A careful record of all amounts so received and forwarded is kept in the Division.

ADMINISTRATIVE WORK.

The administrative work of the Division is immediately in charge of the Editor and Chief. He is aided by the Assistant Chief, the chief clerk, and a small corps of competent clerks, bookkeepers, and typewriters. This work includes all important correspondence of the Division, all the Department's business with the Government Printing Office, the making of all requisitions for printing and binding, the supervision of the work of the branch printing office located at the Department, the keeping of accounts of expenditures, the securing of estimates on all printing, and the direction and supervision of the work of the entire Division.

The following is a comparative statement of the appropriations controlled by the Division of Publications for the fiscal years 1908, 1909, and 1910:

Appropriations for the Division of Publications for the fiscal years 1908–1910.

Appropriation.	1908.	1909.	1910.
Statutory roll of the Division	$126,550	$179,710	$173,450
General printing fund	[a]408,750	[a]435,000	[a]435,000
General expenses of the Division	35,000	40,000	33,000
Total	570,300	654,710	641,450

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[a] Exclusive of $25,000 for Weather Bureau.

EXPENDITURES FOR PRINTING.

The number of requisitions drawn upon the Government Printing Office during the year was 6,895, of which 2,322 were on the main office and 4,573 on the branch office.

The allotment for printing and binding for the Department for the year as provided in the act making appropriations for the sundry civil expenses of the Government was $460,000. Of this amount, $25,000 for the Weather Bureau was expended by that Bureau. Of the remaining $435,000 the expenditures for the various Bureaus, Divisions, and Offices aggregated $312,364.37, being an increase of $6,779.17 over the year 1908; and $122,475.48 were spent for Farmers' Bulletins. There is no regular allotment by the Secretary of amounts that may be spent for the different Bureaus, Divisions, or Offices, each request for printing or binding being considered on its individual merits.

The expenditures from the allotment of $435,000 for printing and binding were as follows:

For the several Bureaus, Divisions, and Offices	$312, 364. 37
For Farmers' Bulletins	122, 475. 48
Total	434, 839. 85
Leaving an unexpended balance of	160. 15

The amount expended from the printing fund for miscellaneous publications and for job printing for each main branch of the Department is shown in the table which follows. The amounts paid for work done in the main office and the Department branch of the Government Printing Office are shown separately.

Amount expended for the various Bureaus, Divisions, and Offices for printing and binding, 1909.

Bureau, Division, Office.	For work done at—		Total.
	Main office.	Branch office.	
Accounts	$4, 171. 46	$1, 485. 39	$5, 656. 85
Animal Industry	19, 411. 44	6, 894. 70	26, 306. 14
Biological Survey	5, 214. 26	473. 93	5, 688. 19
Chemistry	14, 674. 67	2, 716. 77	17, 391. 44
Entomology	7, 191. 84	1, 725. 85	8, 917. 69
Experiment Stations	31, 688. 50	2, 339. 54	34, 028. 04
Forestry	59, 407. 66	9, 823. 36	69, 231. 02
Library	6, 162. 06	278. 45	6, 440. 51
Plant Industry	22, 682. 58	7, 937. 75	30, 620. 33
Publications	10, 164. 58	3, 245. 25	13, 409. 83
Roads	2, 445. 38	410. 68	2, 856. 06
Soils	4, 023. 93	443. 77	4, 467. 70
Statistics	15, 627. 46	6, 315. 16	21, 942. 62
Secretary	13, 035. 42	4, 247. 92	17, 283. 34
Congressional	48, 124. 61	....	48, 124. 61
Total	264, 025. 85	48, 338. 52	312, 364. 37

Expended for Farmers' Bulletins	$122, 475. 48
Expenditure by Weather Bureau	25, 000. 00
Grand total	459, 839. 85

The foregoing tables do not show the character of the work for which the expenditures were made. The following table has been compiled with a view to showing the amounts expended for the different classes of publications and for the job printing and binding:

Expenditures for different classes of publications, etc.

Farmers' Bulletins	$122,475.48
Congressional publications	48,124.61
Periodical publications	35,982.26
Bulletins and circulars (in numbered series)	100,944.30
Administrative and minor publications, job printing, and binding	127,313.20
	434,839.85
Expended by the Weather Bureau	25,000.00
Total	459,839.85

The job printing mentioned in the foregoing statement includes office stationery, circular letters, maps, blank forms, and a variety of miscellaneous supplies, and for these the expenditures were large. Such expenditures have been growing rapidly owing to the increased field work of the Bureau of Animal Industry, the Bureau of Chemistry, and the Forest Service. There has also been a large increase in expenditures for administrative publications issued for the guidance of officers and employees. Naturally, the growth of these expenditures has decreased the amount available for printing bulletins and circulars—the vehicle through which are given to the public the results of original research by the Department. Last year but little more than $100,000 was available to pay for these publications, a sum wholly inadequate to the purpose. Through rigid economy in expenditures for job printing an effort is now being made to prevent further decrease of the sum available for printing bulletins and circulars, but this effort can hardly be expected to materially increase that sum.

That the printing fund was insufficient for the Department's needs during the past year is shown by such facts as the following: Near the close of the year work aggregating in cost nearly $7,000 was forwarded to the Government Printing Office, but could not be undertaken. Many other jobs which were undertaken could not be completed, as the funds were only sufficient to pay "first charges" thereon, and "second charges," aggregating about $40,000, had to be carried over to the current year. It is evident, therefore, that the appropriation of an additional $50,000 is necessary if the Department's actual needs for printing and binding are to be fully met.

DISCONTINUANCE OF INDISCRIMINATE BINDING.

With the view to reducing the volume of binding to the actual requirements of the Department and to restricting the styles of binding to less expensive and more durable materials, the following order was issued by the Secretary:

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., February 20, 1909.

GENERAL ORDER NO. 130.

In compliance with the wishes of the President, and in order to conserve the fund for printing and binding, I have directed the Editor and Chief of the Division of Publications to exercise the closest scrutiny in regard to the binding, and, aside from that ordered for the Library of the Department, the style of which is provided for by law, to authorize no binding of any description for other than office use, and for such purposes the binding to be only in cloth or other material no more expensive. Buckram is considered by the American Library Association as the most durable binding, costing no more than cloth, and its use is recommended.

A bound set of the publications of each Bureau, Division, and Office may be supplied to the Chief and Assistant Chief thereof, the style of binding for such sets to be the same as that heretofore adopted.

No volumes shall be bound in any form for distribution to private individuals, organizations, or libraries, either in this country or abroad. The indiscriminate binding of volumes for the convenience of employees must be discontinued.

The money saved by binding can be spent to better advantage and is actually needed to print information acquired by the Department.

As regards Congressional publications, the Departmental quota need be bound only when the size demands it for the protection of the volume, and then only in the style herein provided.

JAMES WILSON,
Secretary of Agriculture.

S. R. BURCH,
Chief Clerk.

The strict enforcement of this order will undoubtedly result in a considerable saving of money, which is urgently needed for publications. The average cost of binding books of average octavo size in the various styles of binding, with stiff sides, is as follows:

Full green cloth	$1.00
Half green rawhide	1.50
Full fabrikoid	1.00
Full sheep	1.25
Half sheep	1.25
Half roan, red, black, or green	1.50
Half russia, red	1.50
Full russia, red [a]	2.00
Half turkey morocco, red	1.50
Full turkey morocco, red [a]	2.00
Full buckram	1.00

The Department has been using the more expensive bindings, averaging $1.50 per volume. It is apparent, therefore, that, by the adoption wherever possible of buckram, a substantial saving can be effected, and at the same time the durability of the binding can be increased.

EDITORIAL WORK.

Through its editorial work, this Division labors not only for the greatest economy in the expenditure of printing funds, but for improvement in the character of the publications. This work has been carried on in substantially the same manner as heretofore and with no increase in the force.

The Division is well equipped for the editing of manuscripts, the preparation of all copy for publication, and the proof reading and revising. Valuable time and energy would be saved if this work were left entirely to this Division. It is in connection with the editorial work that the details of all printing are worked out in advance, and intimate knowledge of such matters makes it possible to effect the economies which are absolutely necessary to secure the greatest volume of printing and binding from the fund available for such purpose.

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[a] The law forbids the use of these materials with the exception that full red russia may be ordered if the publication is for library purposes.

The effort has been made to facilitate the publication work of the Department and to secure its execution in the best manner consistent with strict economy.

AMOUNT AND CHARACTER OF EDITORIAL WORK.

It is extremely difficult to give an account or a statistical statement which will adequately indicate the great amount of important work done. The following is a tabulated statement of the publications receiving editorial attention during the year:

Publications receiving editorial attention during the year ended June 30, 1909.

Class of publications.	Number.	Printed pages.
Bulletins	110	7,965
Circulars, numbered and unnumbered	301	3,317
Farmers' Bulletins	36	1,128
Reports of Chiefs	17	687
Extracts and separates	62	1,265
Periodicals:		
Experiment Station Record	16	1,671
Crop Reporter	14	111
Reports, numbered	5	1,097
Reports, annual and special	8	4,130
Soil Surveys (advance sheets)	34	1,132
Yearbook	1	798
Congressional documents	12	997
Administrative publications	34	1,167
Total	650	25,465

The number of publications receiving attention was 650, and they contained 25,465 printed pages. Of these, the reports of Chiefs, the extracts and separates, and the Soil Survey advance sheets represent parts issued separately from larger publications. Eliminating these reduces the total number of new publications to 537, with 22,381 pages. All these came to the Division of Publications in manuscript form, and passed out of it in the final form in which they appeared in print. The work on these involved the reading, editing, and preparation of more than 39,000 pages of manuscript, the reading and correcting of more than 8,000 galleys of proof, and the revision of nearly 45,000 pages of first and second page proofs. The work also involved editorial attention to more than 1,400 new illustrations appearing in these publications.

The foregoing figures are based on output. They take no account of work done on manuscripts which were never published, nor on illustrations which were finally omitted. They do not show the reduction in size of publications resulting from editorial criticism. The editorial work is peculiar in this respect, that the more faithfully the force performs its duties, the less there is to show for it in printed pages finally issued.

In addition to the editorial work on publications, much attention must be devoted to the job work. Assistance is given in the preparation of new blank forms, many jobs have to be prepared for the printer, and proof has to be read on all. The fact that 5,000 requisitions for job printing were made during the past year is some indication of the amount of this class of work.

The enormous output of publications, together with the job work of the Department, entails a vast amount of work upon the force. Considerable preliminary preparation on bulletins and circulars is performed before the manuscripts are submitted for publication. This does much to lessen the work, but it does not obviate the necessity for giving careful attention to the manuscript and proof of every publication.

MISCELLANEOUS EDITORIAL WORK.

Many calls have been made for the compilation of matter, for the preparation of abstracts, and for original matter on a wide variety of subjects; and to all such calls prompt and satisfactory responses have been made. Within the past year an assistant editor spent nearly a month in compilation and original work in response to a call on the Secretary for information concerning the beet-sugar industry.

So varied in character has been the miscellaneous work that it has been impracticable to keep an exact record of its amount, or the time it has occupied.

HANDLING AND DISTRIBUTION OF PUBLICATIONS.

Ten years ago there were distributed 3,840,699 copies of publications; last year 16,105,456 copies were distributed. Incidental to this work, ten years ago 7,204 letters were prepared for the signature of the Secretary or the Chief of the Division; last year 46,043 such communications were prepared. These two facts furnish an index of the increased amount of work which year by year the distribution of publications has involved, without a proportionate increase in the number of clerks and skilled laborers. Ten years ago there were 70 employees engaged in such work and this year only 138, showing that, with twice the number of employees, six times the amount of work has been accomplished.

Ten years ago, owing to the insufficient and unsuitable quarters and the character and temporary tenure of a large portion of the employees, the work was heavily handicapped, and it required strenuous exertion to produce comparatively meager results; while now, with ample quarters conveniently arranged and a thorough organization of the force, an immense output is possible. Earnest, incessant, and laborious effort is required and rendered; and, were it not for the machines necessitated by the increase of work and inadequate number of employees, it would have been impossible to perform the work that has been so satisfactorily done.

The frequent loss of experienced and efficient clerks and laborers by transfer to other Departments or Bureaus of this Department, because of larger salaries, results in great inconvenience and detriment to the work. There should be an equalization of salaries so that it will not be necessary for officials to transfer a competent employee to another Bureau in order to reward merit and efficiency.

THE ADDRESSING MACHINES.

The distributing organization has undergone but few alterations as to system, equipment, and force since the report for the year 1908 was made, and the changes that have been made have occurred mostly in the method and the work of addressing and mailing documents. The greater part of the work of addressing envelopes and franks is now done by means of machines. From July 1, 1908, to June 30, 1909, inclusive, 3,721,140 envelopes and franks were addressed, 3,557,059 circulars were folded ready for the envelopes, and 88,056 new stencils were prepared. There are now on hand 1,068,526 stencils, an increase of 851,800 within the year, 764,340 of these being the list of the Forest Service cut in Boston and received during June, 1909.

All mailing lists of the various Bureaus, Divisions, and Offices of the Department have been turned over to this Division, where they are maintained, corrected, and used as occasion requires in mailing publications. This concentration is believed to be in the interest of economy and proper organization. The number of stencils now in use is as follows:

Stencils in use in addressing mail matter.

Agrostology	3, 386
Biological Survey	878
Chemistry	2, 649
Forest Service	764, 340
Library	1, 384
Office of Experiment Stations	13, 051
Bureau of Plant Industry	29, 796
Publications	214, 674
Road Inquiry	3, 552
Statistics	34, 614
Solicitor's Office	202
Total number of stencils	1, 068, 526

The entire force in the addressing-machine room consists of only 9 employees, mostly young men under 20 years of age, receiving salaries of $600 or less. With the recent increase of machinery and stencils made available by the appropriations for the year ended June 30, 1909, and for the next fiscal year, it has been possible to reduce the cost of addressing envelopes from the permanent lists of the Department from $3.25 per thousand, the average cost of hand addressing, to 30 cents, so that now, including the original cost of the stencils, cabinets, and machines, the use of the list nine times saves enough to cover the entire expense, including addressing, and leaves the plant in perfect condition available for instant future use at a cost of one-tenth the previous expense of addressing. The inclusion in the appropriation act for 1909 of an amount to be spent for additional machinery and supplies to be used in addressing and folding envelopes made possible the increase of machine power. The equipment then included two foot-power addressing machines, two foot-power stencil cutters, and two automatic folding machines. To these have been added an electric feed 2½-horsepower addressing machine, two electric-power stencil cutters, one small electric-power hand-feed press, one universal folding machine, and two electric sealing machines; and the $5,000 appropriation for the same object in the act for 1910 will permit the addition of another electric cutter, three small electric hand-feed presses, an additional folding machine, and a franking machine, in addition to furnishing the necessary supplies for the maintenance and extension of the list and the general running of the addressing machines.

FOREIGN MAIL.

The demand for publications of the United States Department of Agriculture by foreign institutions and individuals is increasing from year to year, and the limited amount of postage appropriated for the purpose was exhausted before the close of the fiscal year, so that a considerable number of publications had to be forwarded through the International Exchange of the Smithsonian Institution. The following table shows the number of packages and the weight of the same forwarded to foreign countries for each main branch of the Department, and the total number of packages mailed to all foreign countries:

Number and weight of mailed packages of Department publications on which postage was paid to foreign countries, for each main branch of the Department, during the fiscal year 1909.

Bureau, Division, or Office.	Number of packages.	Weight.	Postage.
		Pounds.	
Division of Publications	15,297	405.4	$184.76
Library	14,439	7,626.5	715.21
Bureau of Chemistry	6,799	1,434.5	114.79
Office of Experiment Stations	6,716	5,089.1	407.13
Bureau of Statistics	4,028	948.5	75.88
Bureau of Entomology	3,966	1,041.0	83.28
Forest Service	3,699	886.7	70.93
Bureau of Animal Industry	3,007	2,053.5	164.28
Bureau of Plant Industry	2,756	1,508.5	120.68
Weather Bureau	1,250	19.0	12.50
Biological Survey	404	800.0	64.00
Office of Public Roads	173	77.7	6.21
Bureau of Soils	99	208.5	16.68
Secretary's Office	74	202.8	16.22
Total for fiscal year 1909	62,707	22,301.7	2,052.55
Total for fiscal year 1908	60,898	20,225.6	1,904.85
Excess over fiscal year 1908	1,809	2,076.1	147.70

Packages of publications sent abroad during fiscal year ended June 30, 1909.

Item.	Number.	Weight.	Postage.
		Pounds.	
Packages sent abroad (Canada, Mexico, and Cuba not included)	62,707	22,301.7	$2,052.55
Packages sent to Canada, Mexico, and Cuba	24,549	4,560.7	None.
Packages sent through International Exchange	2,713	2,898.2	None.
Total	89,969	29,760.6	2,052.55

The work of attending to the foreign mail is done, under the immediate supervision of the assistant in charge, by a clerk who, in addition, performs the duties of time clerk, receiving clerk, and custodian of supplies, who has only one skilled laborer as assistant, and who is receiving only $840 per annum.

MAILING MISCELLANEOUS PUBLICATIONS.

The miscellaneous publications, comprising Yearbooks, annual reports, bulletins, circulars, etc., received from the Government Printing Office during the year ended June 30, 1909, aggregated 9,160,700 copies, and there were on hand July 1, 1908, 1,470,981 copies, making a total supply of 10,631,681. The number distributed was 9,274,455 copies, leaving a balance on hand July 1, 1909, of 1,357,226. The number of miscellaneous publications received this year was 2,532,070 less than last year, and 2,481,301 less were distributed. This decrease requires explanation: In 1908 the Forest Service issued very large editions of several small circulars, which swelled the total copies contributed by that branch of the Department to 4,318,000. The corresponding total for 1909 was only 1,200,000, the decrease being 3,118,000. This far more than covers the entire decrease noted above. There was, in fact, a general increase in publication work all along the line. Even in case of the Forest Service, whose total issue of copies showed such a decided falling off, there was an increase of nearly 50 per cent in the number of pages of new matter published. There was a substantial increase in the distribution of larger publications. The handling of this number of miscellaneous publications, varying in size from a 2-page leaflet to an 800-page Yearbook, was done by the foreman in charge of miscellaneous folding and the men employed in this work; and the storing, wrapping, franking, sacking, and delivering to the city post-office involved a large amount of arduous work, which was faithfully performed.

MAILING FARMERS' BULLETINS.

On the first day of July, 1908, there were on hand 1,298,474 Farmers' Bulletins. During the year ended June 30, 1909, 7,774,648 were received from the Public Printer, making 9,073,122 in all. Of these, 3,960,642 were distributed upon the orders of Senators, Representatives, and Delegates in Congress, and 2,870,359 were mailed to miscellaneous applicants writing directly to the Department, making a total distribution of 6,831,001, and leaving 2,242,121 in the storage rooms.

This work is directed by a forewoman in charge, assisted by a competent and skilled force of laborers, who, in addition to handling 6,831,000 Farmers' Bulletins, folded or mailed (or both in some cases) 3,621,049 small circulars, included among the miscellaneous publications. The force engaged in this work consists entirely of women. The fact that but few complaints of errors were received during the year is the best evidence of the care and skill with which the work was done.

CLERICAL WORK INVOLVED IN DISTRIBUTING PUBLICATIONS.

The documents distributed, including the Farmers' Bulletins, aggregated over 16,000,000 copies. An account was kept with the Public Printer for each and every separate publication received and of each publication distributed, no document being mailed without an order from the Chief of the Division. These orders are the basis of the card system of bookkeeping, which makes the number of each document on hand at the close of the day's business always ascertainable. Orders after being recorded and numbered are filed away systematically and become a part of the record of the daily transactions.

The correspondence connected with the distribution of documents is as stupendous as the number of publications distributed. In addition to the 46,043 typewritten letters, 405,508 replies were made to requests of miscellaneous applicants by means of forms wholly printed or containing blanks to be filled in with pen, and 321,079 mailing orders were prepared. In addition to the lists addressed on the addressing machines, there were addressed by hand 2,251,000 envelopes, franks, and postal cards.

In the prosecution of the work, 125 reams of wrapping paper, 9,572,500 envelopes, and 5,651,000 franks were used, and 21,856 mail sacks were required to convey the publications through the mails.

ILLUSTRATIONS.

During the year 1,061 drawings were prepared by the draftsmen. The bulk of this work was accomplished by three draftsmen as against four for the fiscal year 1908. This showing is very creditable, as one of these three was employed practically the whole year in preparing the intricate working plans for fitting up the laboratories in the new building to be occupied by the Bureau of Chemistry.

If the authors of prospective publications would confer with this Division in the preparation of their illustrations, the results would be more satisfactory in all respects. Only in that way will the illustrations of this Department reach a standard of excellence commensurate with the importance and dignity of the publications.

There has been a marked increase in the photographic work. Additional space was secured and the entire attic floor of the main building, with the exception of the southwest room, is now devoted to the illustration work. Much time was lost while the new rooms were being put in condition for use by the installation of tanks and apparatus. It must still be said that the quarters are ill-adapted and entirely too restricted. The past summer has shown more than ever before the difficulty and loss resulting from the use of such quarters. Attention is again called to the lack of proper ventilation in the photographic laboratories.

The growth of the photographic work is shown by the following comparison: The number of velox and albuma prints made during the fiscal year 1905 was 12,112; during 1909 the number was 31,819. It has never yet been possible to keep this work up to date, nor will it ever be with the present equipment and quarters. This great increase would seem to show that the Department is anxious to avail itself of the illustration facilities offered by this Division, and every effort is being made to meet the growing demand.

Field work in the production of illustrations was done for the Bureau of Animal Industry, the Bureau of Chemistry, the Office of Public Roads, and the Bureau of Plant Industry.

As pictures are used to illustrate reports of investigations conducted by the Department's scientific staff, they should be technically and artistically of the highest order. Negatives made by the scientific force in the field, as well as those made by this Division, are being added to the files. This concentration of negatives greatly facilitates the work and should be encouraged. While some progress has been made in this direction, a great majority of the Department's negatives are still scattered among the offices under the different Bureaus.

There is a constantly increasing demand from miscellaneous applicants for photographic prints, lantern slides, etc. Usually applicants select illustrations from the Department's publications; but often they write for pictures illustrating lines of work being conducted by the Department. Newspaper, magazine, and syndicate writers very often request that they be furnished with photographic prints at the shortest possible notice. Under the present system, in order to comply with these requests, it is necessary for the assistant in charge to go from one office to another in an effort to locate and secure negatives from which prints or slides can be made. The difficulties involved would be greatly reduced if all the negatives, or at least those that are used to illustrate Department publications, were filed and indexed in this Division as already suggested.

SUMMARY OF WORK DONE ON ILLUSTRATIONS.

The following is a detailed statement of the work done for each Bureau as well as the aggregate amount of work:

Photographic work done for the different Bureaus, Divisions, and Offices of the Department and for the public during the fiscal year ended June 30, 1909.

Bureau, Division, or Office.	Velox prints.	Albuma prints.	Blueprints.	Solar bromide prints.	Bromide enlargements.	Prints mounted.	Lantern slides.	Negatives made.	Negatives developed.	Transparencies.
Office of Secretary	26	49								
Assistant Secretary	65	35	100		1		8	26		
Chief Clerk					236	236				
Bureau of Animal Industry	4,260	145	2,409	263	261	536	420	514	1,056	52
Bureau of Chemistry	1,580		1,434	7	13		204	452	386	
Bureau of Entomology	847	1,357			22	22	175	266	142	
Office of Experiment Stations	644	25	831	128	97	19	142	156	150	
Bureau of Plant Industry	15,335	772	817	34	505	155	718	665	2,556	
Division of Publications	238			[a] 40	71	145	110	75	72	
Office of Public Roads	230	483	197		8	8	34	75	160	17
Bureau of Statistics	102			150				20		
Chief Engineer			32							
Biological Survey			6	25						
Paid Orders	611	287					323	10		

[a] Repro prints.

Summary of work on illustrations during the fiscal year ended June 30, 1909.

Photographic work:	
Velox prints	23,938
Albuma prints	3,153
Blueprints	5,826
Repro prints	40
Solar bromide prints	607
Bromide enlargements	1,214
Prints mounted	1,121
Lantern slides	2,134
Negatives made	2,259
Developed plates and films	4,522
Transparencies	69
Paid requisitions (amounting to $286.06)	106
Drawings, electrotypes, etc.:	
Drawings made	1,061
Requests received for duplicate electros	176
Duplicate electros furnished to correspondents on request	2,124
Illustrations printed or published, not including reprints	1,422

INDEXING.

Satisfactory progress has been made in all branches of the indexing work. Additions have been made to the card indexes, many book indexes have been compiled, the circulars of the Division have been revised, the Monthly List has been prepared regularly, and the usual compilation of matter for the Yearbook Appendix has been made. Many requests of a general character for Department publications have been received, and, in responding to such requests, the card indexes have proven indispensable. The number of cards written for card and book indexes during the year was approximately 70,000 and the number of letters written about 5,000. As heretofore, considerable time has been devoted to preparing questions and examining papers for the Civil Service Commission.

The index of publications available for distribution has been kept closely up to date. The aim is to place in this index cards showing every important subject treated in each new publication the day after it is received. While it has not been possible to realize this aim, a closer approximation has been achieved than in foregoing years. Progress has also been made in bringing this index into service. By the use of this index it is possible to prepare without delay lists of available publications, in response to requests for publications on particular subjects as well as requests of a more general character.

The general card index of all Department publications, which was laid aside for lack of help in 1908, has again been taken up. It is hoped that more rapid progress will hereafter be made on this index. It is in every way desirable to push the general index toward completion, and to this end the work is being shaped. This index will supply investigators in every field a ready means of finding what the Department has already done therein, and repetition of research may thus be avoided. Owing in large part to changing demands for this index, much overhauling and revising will be necessary. This index is now being made in triplicate for the convenience of this Division, and the cards in each set will eventually need a thorough revision. The general index is being brought into use by calls for lists of references by the several Bureaus and Offices of the Department, and such calls receive prompt attention.

It is believed that every important publication of the Department should contain a carefully prepared index, especially if it contains 50 or more pages. The indexes of these publications should agree substantially in form, hence the advisability of having them all made in this Division.

BRANCH PRINTING OFFICE.

Under the law of January 12, 1895, the work done in the branch printing office is under the immediate supervision of the Chief of the Division of Publications, who is required to report quarterly to the Secretary upon the work done and the cost thereof. The following is a condensed statement of the work done during the year, the aggregate cost of which was $48,338.52.

The number of requisitions issued on the branch office was 4,573, and these called for the following:

Work done in the branch printing office during the fiscal year 1909.

Copies of minor publications	2,141,963
Blanks	10,626,701
Letter heads and note heads	2,880,010
Envelopes	1,452,530
Cards	4,078,474
Franks	1,402,340
Labels	1,359,029
Lists	478,332
Circular letters	513,675
Miscellaneous	4,546,208
Number of copies padded	8,057,050
Number of copies wrapped	2,144,000
Total	39,680,312

Number of requisitions under which work was done in the branch printing office for the several main branches of the Department.

Secretary's office	436
Division of Accounts and Disbursements	164
Bureau of Animal Industry	462
Bureau of Biological Survey	64
Bureau of Chemistry	307
Bureau of Entomology	205
Office of Experiment Stations	291
Forest Service	746
Library	58
Bureau of Plant Industry	1,122
Division of Publications	173
Office of Public Roads	75
Bureau of Soils	77
Bureau of Statistics	393
Total	4,573

The work done during the year represented the largest amount ever done in the branch office, and the efficiency and promptness with which it was executed deserve special commendation.

During the year four of the old presses were replaced by new ones, and a new cutting machine was installed. An invoice of new type, rule, furniture, improved plate bases, etc., was also received.

Improvements are being made by the Department in the quarters occupied by the branch office, which will contribute greatly to the comfort, convenience, and health of the employees, for all of which the Public Printer has expressed his gratification.

WORK OF THE DIVISION FOR 1910.

During the year 1910 the work of this Division will be continued along the usual lines. This Division has no projects, its function being to do the work required of it by the Secretary and by the several Bureaus, Divisions, and Offices of the Department. As their work grows and their spheres of operation widen the publication work increases. This means an increase in editorial work, in indexing, in photography, in drafting, and in the distribution of published results. It is necessary for this Division to be fully equipped to meet every demand upon it in every branch of its work.

On July 1, 1909, with the beginning of the new fiscal year, the mailing lists of all other Bureaus, Divisions, and Offices, aggregating about 1,500,000 addresses, were turned over to this Division.

Special preparation has been made for their maintenance and use in the distribution of publications.

The additional addressing machines authorized by the last appropriation act will further facilitate the mailing of publications. With increased equipment for addressing envelopes and franks, it will be possible during the coming year to mail all publications to the regular mailing lists without the delays heretofore experienced.

Additions are being made to the photographic equipment, and with the increased force provided for in the appropriation act it is confidently expected that the work can be executed more promptly and efficiently, and that an increased amount of work can be done for the various Bureaus, Divisions, and Offices of the Department.

With an increased indexing force, the Division is now prepared to push the work on the regular card indexes and to do an increased amount of work in preparing indexes of publications. It can also furnish promptly information regarding any subject which has been treated in the publications of the Department, and officials, experts, and investigators of the Department are invited to avail themselves of this source of information.

RECOMMENDATIONS.

The clause carried in the appropriation acts prior to 1908 providing that quotas of Farmers' Bulletins allotted to Senators, Representatives, and Delegates in Congress, but which remained uncalled for after a fixed date, should revert to the Secretary of Agriculture, ought to be included in future appropriation acts.

Of several important publications of this Department, the printing of which is authorized by Congress and which are delivered to the folding rooms of the Senate and House of Representatives, thousands of copies remain undistributed. This is particularly true of the Yearbook, the Department's quota of which is only 30,000 copies. If some provision were made by law for turning over undistributed quotas of these publications at the expiration of a year, the Department would be able to comply with a great many urgent requests for the Yearbook, which under present conditions it is unable to supply. The same is true of some less expensive documents, which are frequently in great demand and which the Department is unable to supply to its correspondents.

For the successful continuance and fuller development of the use of addressing machines a sum should be included in the appropriation bill for 1911 at least sufficient for purchasing necessary supplies and keeping the machines in repair.

There are numerous employees in the Division who have been and are rendering most satisfactory service, whose salaries should be increased as soon as practicable to an amount commensurate with the character of the work and the conspicuous efficiency and fidelity with which it is performed.

PUBLICATIONS ISSUED DURING THE YEAR.

The list of publications issued during the year has been prepared with unusual care. As already stated (see p. 594), it contains a considerable number of administrative and minor publications not listed in earlier reports of this Division. The list is therefore more complete than heretofore.

Important changes in arrangement have been made. The publications contributed by each main branch of the Department are divided into "new publications" and "earlier publications reprinted." Under each of these heads the publications are classified into "Bulletins," "Circulars," "Yearbook Extracts," "Farmers' Bulletins," etc., and the publications in all numbered series appear in numerical order. The old chronological arrangement based on date of issue has been wholly abandoned.

The data given in each entry comprise number (if any), title, author, number of pages, price (if any), date of issue, and number of copies. In case more than one edition was printed, the date and size of each are given, only the total number of copies being carried out to the figure column.

Another innovation appears in the list of Congressional publications. The number of copies ordered by the Department and the number which Congress ordered for the use of its Members appear in parallel columns.

In the preparation of this list economy of space has been made an important object. Explanatory matter appearing on title-pages has been cut out, and abbreviations have been used to a considerable extent.

It is believed that all the changes made are in the nature of improvements, that the list will be found satisfactory for reference purposes, that it is accurate, and that it presents a maximum of information in a minimum of space.

Publications[a] issued during the year ended June 30, 1909, by the U. S. Department of Agriculture: Class, title, author, size, price (if any), date of issue, editions, and total number of copies.

OFFICE OF THE SECRETARY.

CONGRESSIONAL.

New Publications.

	Copies for Department.	Copies for Congress.
Annual Reports:		
Annual Report of the Secretary of Agriculture, 1908. James Wilson. 197 pp. Dec. 24	5,000	
Annual Reports of the Department of Agriculture for the Year Ended June 30, 1908. (Report of the Secretary and Reports of Chiefs.) 862 pp. Mar. 10	1,800	2,887
Yearbook of the Department of Agriculture for 1907. 798 pp. $1. July 27	30,000	331,659
Annual Report of the Office of Experiment Stations for the Year Ended June 30, 1907. 414 pp. 60 cts. Dec. 7	3,000	3,031

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[a] Persons ordering publications from this list should note carefully the following: Farmers' Bulletins are for free distribution by the Members of both branches of Congress and by the Secretary of Agriculture. The same may be said of Soil Survey Advance Sheets. Circulars, Yearbook Extracts, Reports of Chiefs, and other Department publications for which no price is named are for free distribution by this Department so long as the editions last. Orders for Congressional publications for which no price is given should be addressed to Members of Congress. All orders for Bulletins and other priced publications should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C., and the amount of the price should be inclosed in the form of a postal money order. Stamps will not be accepted. Cash will be accepted, but the sender must stand the risk of loss.

Publications issued during the year ended June 30, 1909—Continued.

	Copies for Department.	Copies for Congress.
Annual Reports—Continued.		
Twenty-fourth Annual Report of the Bureau of Animal Industry, 1907. 486 pp. Cloth, 85 cts. Jan. 19	5,000	15,630
Field Operations of the Bureau of Soils, 1906. (Eighth Report.) Milton Whitney and associates in charge of field parties. 1033 pp.; 35 maps in separate pocket. Cloth, $4.40; without maps, 90 cts. Oct. 16	1,000	3,550
Report of the Weather Bureau, 1906–7. 402 pp. Jan. 26	1,000	1,961
Special Report:		
Diseases of Cattle—revised, 1908. Drs. Atkinson, Dickson, Harbaugh, Hickman, Law, Lowe, Mohler, Murray, Pearson, Ransom, Salmon, Smith, and Trumbower. 551 pp. $1. Mar. 27	4,000	91,769
Reports:		
No. 86. Progress of the Beet-Sugar Industry in the United States in 1907. Chas. F. Saylor. 88 pp. 10 cts. Sept. 11	5,000	1,562
No 90. Progress of the Beet-Sugar Industry in the United States in 1908. Charles F. Saylor. 74 pp. 10 cts. June 17	5,000	1,127
Soil Surveys (Advance Sheets, Field Operations of the Bureau of Soils, 1907):		
Morton Area, North Dakota. 26 pp. July 23	1,000	3,000
Bastrop County, Texas. 46 pp. Aug. 13	1,000	3,000
Cooper Area, Texas. 24 pp. Aug. 13	1,000	3,000
Jefferson County, Florida. 39 pp. Aug. 15	1,000	3,000
McKenzie Area, North Dakota. 25 pp. Aug. 22	1,000	3,000
Brownsville Area, Texas. 32 pp. Aug. 22	1,000	3,000
Talladega County, Alabama. 40 pp. Oct. 3	1,000	3,000
Marion County, Indiana. 24 pp. Oct. 6	1,000	3,000
Henderson County, North Carolina. 25 pp. Oct. 21	1,000	3,000
North Platte Area, Nebraska. 28 pp. Oct. 31	1,000	3,000
Lee County, South Carolina. 27 pp. Oct. 31	1,000	3,000
Prentiss County, Mississippi. 25 pp. Nov. 7	1,000	3,000
Montgomery County, Virginia. 37 pp. Nov. 7	1,000	3,000
Redding Area, California. 31 pp. Nov. 14.	1,000	3,000
Jasper County, Mississippi. 36 pp. Nov. 21	1,000	3,000
Bellefourche Area, South Dakota. 31 pp. Dec. 9	1,000	3,000
Oktibbeha County, Mississippi. 40 pp. Dec. 9	1,000	3,000
Oconee County, South Carolina. 32 pp. Dec. 16	1,000	3,000
Minidoka Area, Idaho. 22 pp. Dec. 21	1,000	3,000
Marion County, Alabama. 24 pp. Dec. 30	1,000	3,000
Sumter County, South Carolina. 27 pp. Jan. 2	1,000	3,000
Colusa Area, California. 50 pp. Jan. 9	1,000	3,000
Robertson County, Texas. 54 pp. Jan. 9	1,000	3,000
Butte Valley, California. 18 pp. Jan. 15	1,000	7,000
Butler County, Alabama. 33 pp. Jan. 28	1,000	3,000
Bellingham Area, Washington. 39 pp. Feb. 3	1,000	3,000
Middlebourne Area, West Virginia. 32 pp. Feb. 15	1,000	5,000
Easton Area, Maryland. 47 pp. Mar. 11	1,000	3,000
Johnstown Area, Pennsylvania. 44 pp. Mar. 17	1,000	3,000
Winn Parish, Louisiana. 37 pp. Mar. 27	1,000	3,000
Dutchess County, New York. 53 pp. Mar. 31	1,000	3,000
Giles County, Tennessee. 23 pp. Apr. 5	1,000	3,000
Soil Surveys (Advance Sheets, Field Operations of the Bureau of Soils, 1908):		
Overton County, Tennessee. 24 pp. June 30	1,000	3,000
Lamar County, Alabama. 32 pp. June 30	1,000	3,000
House Documents (60th Cong., 2d sess.):		
No. 1078. Employees under the Meat Inspection Law, etc., Fiscal Year 1908. Statement Submitted by the Secretary of Agriculture. 101 pp		661
No. 1149. Expenditures for Travel from Washington to Points Outside, by Officers and Employees of the Department of Agriculture, Fiscal Year 1908. 127 pp. Jan. 6	100	1,597

Publications issued during the year ended June 30, 1909—Continued.

	Copies for Department.	Copies for Congress.
House Documents (60th Cong., 2d sess.)—Continued.		
No. 1157. Statement of Expenditures of the Department of Agriculture for the Fiscal Year ended June 30, 1908. 519 p. Jan. 21	100	1,076
No. 1169. Communication from the Secretary of Agriculture asking for a deficiency appropriation on account of an outbreak of foot-and-mouth disease. 3 pp		661
No. 1215. Estimate of appropriation for equipping new laboratory, by the Secretary of Agriculture. 2 pp		661
No. 1221. Combined Report of Expenditures during Fiscal Year 1908, Appropriations for 1909, and Proposed Expenditures for 1910. (Quarto.) 165 pp. Jan. 14	100	661
No. 1248. Estimate of appropriation for fence for National Bison Range, by the Secretary of Agriculture. 2 pp		661
No. 1249. Report of Expenditures by the Bureau of Chemistry to compensate persons employed by state, county, or municipal governments. 1 p		661
No. 1271. Report of Forest Service Showing Expenditures for Fiscal Year 1908, Appropriations for 1909, and Expenditures Proposed for 1910. 38 pp. (Quarto)	100	661
No. 1438. Supplemental estimates of deficiency appropriation, by the Secretary of Agriculture on account of the outbreak of foot-and-mouth disease. 5 pp		661
Senate Documents:		
No. 734 (60th Cong., 2d sess.). Estimate of appropriation for Commission on Country Life, by the Secretary of Agriculture. 2 pp		661
No. 22 (61st Cong., 1st sess.). The Beet-Sugar Industry in the United States. Letter from the Secretary of Agriculture transmitting information. 32 pp. May		661

DEPARTMENTAL.

NEW PUBLICATIONS.

	Copies.
Reports:	
No. 87. Report of the Secretary of Agriculture, 1908 (abridged edition). James Wilson. 100 pp. Feb. 6	51,000
No. 88. Influence of Sodium Benzoate on the Nutrition and Health of Man. Russell H. Chittenden, John H. Long, and Christian A. Herter. 784 pp. $1. May 4	1,000
No. 89. Durability and Economy in Papers for Permanent Records. (A report by H. W. Wiley and C. Hart Merriam, committee on paper for departmental use.) 51 pp. 15 cts. Apr. 22	4,000
Circulars:	
No. 21, 2d revision. Rules and Regulations for the Enforcement of the Food and Drugs Act. 20 pp. June 8	10,000
No. 27. Tests of Bruschettini's Hog Cholera Vaccine and Bruschettini's Hog Cholera and Swine Plague Serum. James Wilson. 2 pp. Dec. 18, 3,700; Jan. 6, 1,500; Jan. 16, 1,000	6,200
No. 28. The Adulteration and Misbranding of the Seed of Red Clover, Alfalfa, Orchard Grass, and Kentucky Bluegrass. 5 pp. Mar. 17	5,000
No. 29. Tests of Roberts's So-called Anti-Abortion Serum. 1 pp. June 2	3,500
Annual Reports:	
Report of the Secretary of Agriculture for 1908. James Wilson. Edition for the press. 185 pp. Dec. 4	3,000
Report of the Appointment Clerk for 1908. J. B. Bennett. (From An. Rpts. of Dept., 1908.) 22 pp. Dec. 14	1,000
Report of the Solicitor for 1908. George P. McCabe. (From An. Rpts. of Dept., 1908.) 30 pp. Dec. 14	2,500
Report on Building Operations for 1908. B. T. Galloway. (From An. Rpts. of Dept., 1908.) 5 pp. Dec. 17	500

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Circulars of the Solicitor's Office:	
No. 6. The Twenty-eight-Hour Law. Opinion of District Judge Dietrich. 7 pp. July 9	500
No. 7. The Twenty-eight-Hour Law. Charge to the Jury by District Judge Lewis. 5 pp. Aug. 17	200
No. 8. The Twenty-eight-Hour Law. Opinions of District Judge Wolverton. 3 pp. Aug. 13	150
No. 9. The Twenty-eight-Hour Law. Opinion of District Judge De Haven. 4 pp. Sept. 23	150
No. 10. The Food and Drugs Act. Opinion of District Judge Morris. 2 pp. Dec. 2	150
No. 11. The Twenty-eight-Hour Law. Charge to the Jury by District Judge Meek. 4 pp. Dec. 17	150
No. 12. The Twenty-eight-Hour Law. Opinion of Circuit Judge Ross. 4 pp. Jan. 6	500
No. 13. The Cattle Quarantine Law. Opinion of District Judge Evans. 7 pp. Jan. 20	500
No. 14. The Twenty-eight-Hour Law. Opinion of Circuit Court of Appeals (Circuit Judges Van Deventer, Hook, and Adams). 6 pp. Mar. 29	1,000
No. 15. The Twenty-eight-Hour Law. Opinion of the Circuit Court of Appeals (Circuit Judges Colt, Putnam, and Lowell). 13 pp. Apr. 2	1,500
No. 16. The Twenty-eight-Hour Law. Opinion of the Circuit Court of Appeals (Circuit Judges La Combe, Cox, and Ward). 2 pp. Apr. 14	1,500
No. 17. The Twenty-eight-Hour Law. Opinion of Circuit Court of Appeals (Circuit Judges Sanborn and Van Deventer, and District Judge Munger). 5 pp. Apr. 28	1,500
No. 18. The Twenty-eight-Hour Law. Opinion of the Circuit Court of Appeals (Circuit Judges Sanborn and Van Deventer and District Judge Amidon). 4 pp. May 11	1,500
No. 19. The Twenty-eight-Hour Law. Opinion of District Judge Holt. 3 pp. June 30	1,500
Food Inspection Decisions:	
No. 97. "Soaked-Curd" Cheese. 2 pp. Oct. 30	20,000
No. 98. The Labeling of Whisky Compounds. 2 pp. Dec. 8	20,000
No. 99. Change in Form of Guaranty Legend. 2 pp. Dec. 14, 20,000; Mar. 5, 10,000	30,000
No. 100. Bleached Flour. 1 p. Dec. 10, 20,000; Apr. 26, 5,000	25,000
No. 101. Benzoate of Soda. 1 p. Dec. 29	20,000
No. 102. Entry of Vegetables Greened with Copper Salts. 1 p. Dec. 29	20,000
No. 103. The Labeling of Turpentine. 1 p. Jan. 28	20,000
No. 104. Amendment to Decisions Nos. 78 and 89 Relating to the Use in Foods of Benzoate of Soda. 3 pp. Mar. 11	25,000
No. 105. The Labeling of Canned Salmon and White Fish. 2 pp. Mar. 17	20,000
No. 106. Amendment to Decision No. 77 (definition of "Batch" and "Mixtures"). 1 p. Mar. 29	20,000
No. 107. Decision of the Attorney-General in Regard to the Legality of the Referee Board. 6 pp. May 4	20,000
No. 108. Importation of Coffee. 1 p. June 22	20,000
Notices of Judgment, Food and Drugs Act:	
No. 3. Misbranding Flour. 2 pp. July 3	15,000
No. 4. Misbranding of Coffee. 3 pp. Aug. 4	15,000
Nos. 5–11. Misbranding: 5, Vanilla Extract; 6, Cider; 7, Eggs; 10, Cocain Hydrochlorid. Adulteration: 8, 9, and 11, Milk. 10 pp. Aug. 13	15,000
Nos. 12–17. Misbranding: 12, 13, and 17, Flour; 14, Vanilla Extract; 16, A Drug Product (Sartoin Skin Food); 15, Adulteration and Misbranding of Whisky. 13 pp. Oct. 10	20,000
Nos. 18–21. Misbranding and Adulteration of Honey. 7 pp. Oct. 2	20,000

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Notices of Judgment, Food and Drugs Act—Continued.	
Nos. 22–24. 22, Misbranding of Eggs. Misbranding and Adulteration: 23, Vinegar; 24, Molasses. 7 pp. Nov. 12	15,000
No. 25. Misbranding of a Drug (Harper's Cuforhedake Brane-Fude). 11 pp. Nov. 25	15,000
Nos. 26–27. Misbranding of Canned Blackberries. 4 pp. Nov. 18	15,000
Nos. 28–35. Misbranding: 29, a Drug Product (Liquid Sulphur); 30, a Drug Product (Concentrated Oil of Pine Compound); 32, a Drug Product (Blackburn's Cascara, Wild Lemon, etc.); 33, Maple Sirup; 34 and 35, Canned Peaches. Misbranding and Adulteration: 28, Pepper; 31, Buckwheat Flour. 13 pp. Dec. 28	15,000
Nos. 36–37. 36, Misbranding of Canned Apples and Blackberries. 37, Adulteration of Milk. 7 pp. Jan. 30	15,000
No. 38. Misbranding of Canned Corn. 2 pp. Mar. 17	15,000
Nos. 39–42. Misbranding: 39, Corn and Beans; 40, Canned Corn; 42, Butter. 41, Adulteration of Water (Great Bear Spring Water). 7 pp. Mar. 16	15,000
Nos. 43–47. Misbranding: 43, Canned Peas; 44, Meal; 47, Maple Sirup. 45, Adulteration and Misbranding of Whisky. 46, Adulteration of Eggs. 11 p. Apr. 1	15,000
Nos. 48–49. 48, Adulteration and Misbranded Vanilla Extract. 49, Misbranding of Coffee. 4 pp. Apr. 5	15,000
No. 50. Adulteration of Coffee. 2 pp. Apr. 14	15,000
Nos. 51–53. Misbranding: 51, Bottled Beer; 52 and 53, Canned Corn. 7 pp. Apr. 15	15,000
Nos. 54–55. Misbranding: 54, a Drug (Muco-Solvent); 55, Coffee. 4 pp. May 4	15,000
Nos. 56–57. Misbranding: 56, Lemon Extract; 57, Canned Corn. 4 pp. May 11	15,000
Nos. 58–63. Adulteration and Misbranding: 58, Oats; 59, Lithia Water; 60, Buckwheat Flour. Misbranding: 61 and 62, Vinegar; 63, Canned Corn. 12 pp. May 17	15,000
Nos. 64–65. Misbranding: 64, Canned Apples; 65, Beer. 4 pp. May 22	15,000
Nos. 66–67. 66, Misbranding and Adulteration of Stock Feed. 67, Misbranding of Butter. 5 pp. May 29	15,000
No. 68. Misbranding of Whisky. 6 pp. June 2	15,000
Miscellaneous Circulars:	
Regulations and Decisions Concerning Guaranties and Serial Numbers and their Use. 13 pp. Aug. 22, 1,000; Sept. 4, 10,000; Apr. 29, 10,000	21,000
Civil-Service Regulations Governing Promotions, etc., in the Department of Agriculture. 4 pp. Feb. 1	1,000

EARLIER PUBLICATIONS REPRINTED.

Circular:	
No. 19. Standards of Purity for Food Products. 19 pp. Sept. 30	5,000
Food Inspection Decisions:	
Nos. 40–43. 40, Filing Guaranty. 41, Approval of Labels. 42, Mixing Flours. 43, Relabeling of Goods on Hand. 4 pp. Nov. 10	5,000
Nos. 44–45. 44, Scope and Purpose of Food Inspection Decisions. 45, Blended Whiskies. 3 pp. Apr. 24	5,000
Nos. 46–48. 46 (amended), Fictitious Firm Names. 47, Flavoring Extracts. 48, Substances Used in Preparation of Foods. 4 pp. Apr. 24	5,000
Nos. 49–53. 49, Time Required to Reach Decisions. 50, Imitation Coffee. 51, Coloring Butter and Cheese. 52, Form of Label. 53, Formula on Label of Drugs. 6 pp. Dec. 7, 5,000; Apr. 16, 10,000	15,000
Nos. 54–59. (Relating to drugs and medicines.) 7 pp. Dec. 20, 5,000; Apr. 29, 10,000	15,000
Nos. 60–64. 60, Minor Border Importations. 61, Cocoa Butter Substitutes. 62, Guaranty on Imported Food Products. 63, Use of Word "Compound" in Names of Drug Products. 64, Labeling Sardines. 6 pp. Nov. 3, 5,000; Apr. 16, 10,000	15,000

Publications issued during the year ended June 30, 1909—Continued.

Food Inspection Decisions—Continued.	Copies.
Nos. 66–68. 66, Use of Sugar in Canned Goods. 67, Polishing and Coating Rice. 68, Labeling Products, "Manufactured for," etc. 5 pp. Oct. 24, 3,000; Dec. 22, 5,000; Apr. 22, 10,000	18,000
No. 69. Inspection of Food and Drugs and Identification of Inspector. 2 pp. Oct. 31, 3,000; Apr. 28, 5,000	8,000
No. 73. Interstate Transportation of Imported Meats, etc. 2 pp. Apr. 26	5,000
No. 74. Certificates for Imported Meats and Meat-food Products. 3 pp. Dec. 19	5,000
No. 75. Labeling of Mixtures of Cane and Maple Sirup. 2 pp. Apr. 21	5,000
No. 77. Certificate and Control of Dyes Permissible in Coloring Foods and Foodstuffs. 6 pp. Apr. 27	5,000
Nos. 78–79. 78, Use of Labels after Oct. 1, 1907. 79, Collection of Samples. 4 pp. Apr. 24	5,000
Nos. 80–81. 80, Glazed Coffee. 81, Labeling of Caramels. 4 pp. Apr. 27	5,000
No. 82. Labeling of Coffee Produced in the Dutch East Indies. 2 pp. Apr. 26	5,000
No. 83. Issue of Guaranty Based upon a Former Guaranty. 8 pp. May 6	5,000
No. 86. Original Packages: Interpretation of Regulation 2. 16 pp. Apr. 29	5,000
No. 87. Labeling of Corn Sirup. 2 pp. Apr. 21	5,000
No. 88. Private Importations. 2 pp. Apr. 22	5,000
No. 89. Amendment to Decision 76, Relating to Use of Benzoate of Soda and Sulphur Dioxide. 2 pp. Apr. 22	5,000
No. 92. The Use of Copper Salts in the Greening of Foods. 4 pp. Aug. 7	5,000
Nos. 93–95. 93, Amendment to Regulation 34. 94, Labeling of Medicinal and Table Waters. 95, Use of Neutral Spirits Produced from Beet-Sugar Molasses in Preparation of Whisky Compounds, etc. 4 pp. Apr. 24	5,000
No. 96. Serial Number Guaranty. 2 pp. Apr. 27	5,000

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

NEW PUBLICATION.

Annual Report:	
Report of the Chief of the Division for 1908. A. Zappone. (From An. Rpts. of Dept., 1908.) 4 pp. Dec. 17	200

BUREAU OF ANIMAL INDUSTRY.

NEW PUBLICATIONS.

Bulletins:	
No. 39. Index Catalogue of Medical and Veterinary Zoology. Ch. Wardell Stiles and Albert Hassall. Part 21. (Authors: O to Ozzard.) 52 pp. 10 cts. July 8	2,000
No. 39, Part 22. (Authors: P to Pfeilsticker.) 97 pp. 15 cts. Feb. 15	2,000
No. 39, Part 23. (Authors: Pfender to Qvortrup.) 90 pp. 15 cts. Feb. 16	2,000
No. 107. Analysis of Coal-Tar Creosote and Cresylic Acid Sheep Dips. Robert M. Chapin. 35 pp. 10 cts. July 17	2,000
No. 108. Feeding for Meat Production. H. P. Armsby. 89 pp. 10 cts. Dec. 31, 1,500; June 29, 500	2,000
No. 109. Proteolytic Changes in the Ripening of Cheese. Arthur W. Dox. 24 pp. 5 cts. Nov. 28	1,800
No. 110. A Biometrical Study of Egg Production in the Domestic Fowl. Part I. Variation in Annual Egg Production. Raymond Pearl and Frank M. Surface. 80 pp. 15 cts. May 28	1,800
No. 111. A Chemical and Physical Study of the Small and Large Fat Globules in Cow's Milk. R. H. Shaw and C. H. Eckles. 16 pp. 5 cts. Jan. 11	2,000

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Bulletins—Continued.	
No. 112. The Loco-Weed Disease of the Plains. C. Dwight Marsh. 130 pp. 35 cts. June 25	1,000
No. 113. Filtration Experiments with *Bacillus choleræ suis.* C. N. McBryde. 31 pp. 10 cts. June 21	3,000
No. 114. The Influence of Acidity of Cream on the Flavor of Butter. L. A. Rogers and C. E. Gray. 22 pp. 10 cts. June 11	2,500
Circulars:	
No. 74, revised. Legal Standards for Dairy Products. 2 pp. Mar. 6	2,600
No. 130. Paraffining Butter Tubs. L. A. Rogers. 6 pp. Dec. 17	7,500
No. 133. Report and Recommendations Regarding Veterinary Colleges in the United States. A. D. Melvin. 13 pp. July 6, 2,000; Aug. 12, 1,000; June 11, 500	3,500
No. 134. Classified List of Available Publications of the Bureau. 8 pp. Sept. 26	6,300
No. 135. Officials, Organizations, and Educational Institutions Connected with the Dairy Interests. 31 pp. Nov. 20	3,500
No. 136. How to Build a Stave Silo. B. H. Rawl and J. A. Conover. 18 pp. Jan. 9, 3,750; Apr. 21, 2,000	5,750
No. 137. The Preservation of our Native Types of Horses. George M. Rommel. 62 pp. Oct. 28, 10,000; Feb. 2, 3,000	13,000
No. 138. Infectious Anemia or Swamp Fever of Horses. John R. Mohler. 4 pp. Mar. 6, 3,500; Apr. 17, 2,000	5,500
No. 139. The Score-Card System of Dairy Inspection. C. B. Lane and Geo. M. Whitaker. 32 pp. Apr. 17	3,500
No. 140. The Egg Trade of the United States. Milo M. Hastings. 34 pp. Apr. 8, 7,500; May 12, 2,000	9,500
No. 141. Foot-and-Mouth Disease. D. E. Salmon and Theobald Smith. 8 pp. Nov. 23, 6,500; Dec. 8, 20,000	26,500
No. 142. Some Important Factors in the Production of Sanitary Milk. Ed. H. Webster. 20 pp. Jan. 22, 2,500; Apr. 24, 1,000	3,500
No. 143. Milk and Its Products as Carriers of Tuberculosis Infection. E. C. Schroeder. 17 pp. Jan. 22, 2,500; Apr. 23, 1,000	3,500
No. 144. Tuberculosis of Hogs: Its Cause and Suppression. John R. Mohler and Henry J. Washburn. 36 pp. Feb. 10	1,800
No. 145. The Care and Testing of Camembert Cheese. Charles Thom. 7 pp. Jan. 30	1,800
No. 146. Fishy Flavor in Butter. L. A. Rogers. 20 pp. Apr. 28	9,000
No. 147. The Origin of the Recent Outbreak of Foot-and-Mouth Disease in the United States. John R. Mohler and Milton J. Rosenau. 29 pp. June 16	7,500
No. 148. A Practical Demonstration of a Method for Controlling the Cattle Tick. W. D. Hunter and J. D. Mitchell. 4 pp. Apr. 21	6,000
Annual Report:	
Report of the Chief of the Bureau for 1908. A. D. Melvin. (From An. Rpts. of Dept., 1908.) 68 pp. Dec. 30	2,500
Yearbook Extracts:	
No. 444. Bacteria in Milk. L. A. Rogers. (From Ybk. 1907.) 18 pp. Aug. 6	5,000
No. 457. Hygienic Water Supplies for Farms. B. M. Bolton. (From Ybk. 1907.) 13 pp. Aug. 22	2,500
Separates from Twenty-fourth Annual Report of Bureau (1907):	
Embryonal Adenosarcoma of the Kidney in Swine. L. Enos Day. 14 pp. Jan. 19	500
Effect of Certain Diseases and Conditions of Cattle upon the Milk Supply. John R. Mohler. 19 pp. Jan. 21, 1,000; May 29, 2,000	3,000
Dermal Mycosis Associated with Sarcoptic Mange in Horses. A. D. Melvin and John R. Mohler. 21 pp. Feb. 1	500
A Study of the Methods of Canning Meats, with Reference to the Proper Disposal of Defective Cans. C. N. McBryde. 20 pp. Mar. 27	2,500
Report of a Commission on Certain Features of the Federal Meat-Inspection Regulations. 15 pp. Apr. 10	1,000

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Service Announcements:[a]	
No. 15. For July, 1908. 8 pp. July 21	3,500
No. 16. For August, 1908. 11 pp. Aug. 21	3,500
No. 17. For September, 1908. 8 pp. Sept. 16	3,600
No. 18. For October, 1908. 12 pp. Oct. 19	3,600
No. 19. For November, 1908. 11 pp. Nov. 19	5,000
No. 20. For December, 1908. 12 pp. Dec. 17	5,000
No. 21. For January, 1909. 11 pp. Jan. 16	5,000
No. 22. For February, 1909. 8 pp. Feb. 17	5,000
No. 23. For March, 1909. 7 pp. Mar. 19	5,000
No. 24. For April, 1909. 10 pp. Apr. 16	5,000
No. 25. For May, 1909. 8 pp. May 19	5,000
No. 26. For June, 1909. 8 pp. June 15	5,000
Index to Service Announcements for 1908. 6 pp. Jan. 11	3,000
Meat Inspection Directories:	
Directory, revised to July 1, 1908. 38 pp. July 31	4,000
Same, revised to October 9, 1908. 39 pp. Nov. 5	5,000
Same, revised to January 13, 1909. 39 pp. Jan. 18	4,000
Same, revised to April 1, 1909. 41 pp. Apr. 13	4,000
Miscellaneous Circulars:	
Regulations Governing the Meat Inspection of the Department as Amended, Effective May 1, 1908. (Order 150, rev.) 49 pp. Oct. 31, 5,000; June 22, 15,000	20,000
Publications of Interest to Dairymen, revised to August 1, 1908. 5 pp. Aug. 4	1,000
Same, revised to February 1, 1909. 5 pp	4,000
Classified List of Available Publications of the Bureau (for foreign distribution). 8 pp. Oct. 3	300
Farmers' Bulletins:	
No. 137, revised. The Angora Goat. George F. Thompson. (Revised by Edward L. Shaw, 1908.) 48 pp. Nov. 30	15,000
No. 345. Some Modern Disinfectants. M. Dorset. 12 pp. Dec. 18, 15,000; May 28, 10,000	25,000
No. 346. Computation of Rations for Farm Animals by the Use of Energy Values. H. P. Armsby. 32 pp. Jan. 25, 15,000; Apr. 8, 10,000; June 15, 10,000	35,000
No. 348. Bacteria in Milk. L. A. Rogers. 24 pp. Jan. 21, 15,000; Apr. 19, 10,000; June 3, 15,000	40,000
No. 349. The Dairy Industry in the South. B. H. Rawl, Duncan Stuart, and Geo. M. Whitaker. 39 pp. Feb. 11, 20,000; May 18, 20,000	40,000
No. 350. The Dehorning of Cattle. Richard W. Hickman. 16 pp. Feb. 6, 20,000; May 27, 15,000	35,000
No. 351. The Tuberculin Test of Cattle for Tuberculosis. John R. Mohler. 8 pp. Feb. 8, 10,000; Mar. 17, 10,000; June 11, 10,000	30,000
No. 357. Methods of Poultry Management at the Maine Agricultural Experiment Station. Raymond Pearl. 39 pp. May 20, 15,000; June 27, 20,000	35,000

EARLIER PUBLICATIONS REPRINTED.

Bulletins:	
No. 58. The Fat Testing of Cream by the Babcock Method. Ed. H. Webster and C. E. Gray. 29 pp. 5 cts. Dec. 14	1,000
No. 92. The Milking Machine as a Factor in Dairying. I. Practical Studies of a Milking Machine. C. B. Lane. II. Bacteriological Studies of a Milking Machine. W. A. Stocking, jr. 55 pp. 15 cts. Dec. 23	1,000
No. 102. Further Experiments Concerning the Production of Immunity from Hog Cholera. M. Dorset, C. N. McBryde, and W. B. Niles. 96 pp. 15 cts. Jan. 11, 500; May 28, 2,000	2,500
No. 104. Medical Milk Commissions and the Production of Certified Milk in the United States. C. B. Lane. 43 pp. Oct. 6	1,000

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[a] Not for general circulation, but for distribution to persons in the service of the Bureau, and to proprietors of establishments covered by the meat inspection.

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Circulars:	
No. 23, 3d revision. Directions for the Use of Blackleg Vaccine. 8 pp. Nov. 21	10,000
No. 56. Facts Concerning the History, Commerce, and Manufacture of Butter. Harry Hayward. 26 pp. Aug. 8, 500; Dec. 5, 2,000	2,500
No. 65. Ophthalmia in Cattle. M. R. Trumbower. 2 pp. Jan. 16	1,000
No. 67. Abortion or Slinking of the Calf. James Law. 11 pp. July 29, 500; Nov. 17, 2,000; May 28, 2,000	4,500
No. 70. Tuberculosis of Cattle. D. E. Salmon and Theobald Smith. 28 pp. Nov. 30	3,000
No. 71. Anthrax in Cattle, Horses, and Men. D. E. Salmon and Theobald Smith. 10 pp. Nov. 19	2,000
No. 75. Feeding Fat into Milk, or the Effect of Food upon the Quality of Milk Produced. Chas. D. Woods and A. W. Bitting. 43 pp. July 28	500
No. 78. Glanders and Farcy. Rush Shippen Huidekoper and Leonard Pearson. 12 pp. Nov. 17	2,000
No. 79. The Tuberculin Test for Tuberculosis. D. E. Salmon. 14 pp. July 29	2,000
No. 94. Foot-Rot of Sheep. John R. Mohler and Henry J. Washburn. 22 pp. Nov. 20, 1,000; May 13, 1,000	2,000
No. 96. Actinomycosis, or Lumpy Jaw. D. E. Salmon and Theobald Smith. 10 pp. Nov. 19	2,000
No. 102. Stomach Worms (*Hæmonchus contortus*) in Sheep. B. H. Ransom. 7 pp. May 28	2,000
No. 103. Records of Dairy Cows: Their Value and Importance in Economic Milk Production. C. B. Lane. 38 pp. Sept. 17, 1,000; Nov 25, 3,000	4,000
No. 107. Capons and Caponizing. Rob R. Slocum. 10 pp. June 8	2,000
No. 114. Sanitary Milk Production: Report of a Conference Appointed by the Commissioners of the District of Columbia, with Accompanying Papers. 38 pp. Aug. 27, 2,500; Nov. 11, 5,000	7,500
No. 117. A City Milk and Cream Contest as a Practical Method of Improving the Milk Supply. C. B. Lane and Ivan C. Weld. 20 pp. Oct. 1	2,000
No. 118. The Unsuspected but Dangerously Tuberculous Cow. E. C. Schroeder. 19 pp. Sept. 9, 2,500; Nov. 10, 5,000; Apr. 23, 2,000	9,500
No. 120. Some Observations on Rabies. E. C. Schroeder. 16 pp. Apr. 16	2,000
No. 122. Epizootic Cerebro-Spinal Meningitis of Horses. R. W. Hickman. 8 pp. Oct. 27	2,000
No. 125. The Federal Meat Inspection Service. A. D. Melvin. 40 pp. July 1	1,000
No. 127. Tubercle Bacilli in Butter: Their Occurrence, Vitality, and Significance. E. C. Schroeder and W. E. Cotton. 23 pp. Nov. 18	3,000
No. 128. White Diarrhea of Chicks: With Notes on Coccidiosis in Birds. Geo. Byron Morse. 7 pp. July 13, 500; Aug. 28, 1,000; Nov. 16, 2,000; June 18, 1,000	4,500
No. 129. Rabies and Its Increasing Prevalence. George H. Hart. 26 pp. July 29	3,000
No. 131. Designs for Dairy Buildings. Ed. H. Webster. 26 pp. Oct. 21, 2,000; Jan. 18, 2,000	4,000
No. 132. A Practical Method for the Detection of Beef Fat in Lard. James A. Emory. 9 pp. Aug. 6	500
Farmers' Bulletins:	
No. 24. Hog Cholera and Swine Plague. D. E. Salmon. 15 pp. Sept. 9, 15,000; Nov. 7, 10,000; Mar. 16, 10,000; May 27, 15,000	50,000
No. 42, revised. Facts about Milk. R. A. Pearson. 32 pp. July 29, 10,000; Oct. 5, 10,000; Nov. 21, 10,000; Feb. 24, 10,000; Apr. 8, 10,000; June 14, 15,000; June 22, 10,000	75,000
No. 49. Sheep Feeding. John A. Craig. 30 pp. Sept. 23, 10,000; Mar. 29, 10,000	20,000

Publications issued during the year ended June 30, 1909—Continued.

Farmers' Bulletins—Continued.	Copies.
No. 51, revised. Standard Varieties of Chickens. George E. Howard. (Revised by G. Arthur Bell, 1906.) 48 pp. Aug. 11, 20,000; Sept. 22, 15,000; Nov. 9, 20,000; Mar. 9, 15,000; Apr. 7, 15,000; May 10, 15,000; June 18, 20,000	120,000
No. 55, revised. The Dairy Herd: Its Formation and Management. Henry E. Alvord. 31 pp. Aug. 7, 10,000; Oct. 6, 10,000; Nov. 5, 10,000; Feb. 23, 10,000; May 18, 15,000	55,000
No. 63, revised. Care of Milk on the Farm. R. A. Pearson. 40 pp. Aug. 6, 10,000; Oct. 15, 10,000; Feb. 8, 10,000; Mar. 22, 10,000; June 18, 10,000	50,000
No. 64, revised. Ducks and Geese: Standard Varieties and Management. George E. Howard. (Revised by G. Arthur Bell, 1906.) 55 pp. July 29, 10,000; Nov. 4, 10,000; Mar. 24, 10,000; June 1, 10,000	40,000
No. 71. Some Essentials in Beef Production. Charles F. Curtis. 23 pp. Sept. 9, 10,000; Mar. 26, 5,000; May 27, 10,000	25,000
No. 96. Raising Sheep for Mutton. Charles F. Curtis. 48 pp. Sept. 4, 10,000; Apr. 12, 10,000	20,000
No. 100. Hog Raising in the South. S. M. Tracy. 40 pp. Aug. 4, 10,000; Nov. 9, 10,000; Mar. 27, 10,000; June 8, 10,000	40,000
No. 106. Breeds of Dairy Cattle. Henry E. Alvord. 48 pp. July 21, 10,000; Oct. 9, 15,000; Oct. 29, 10,000; Apr. 29, 10,000; June 15, 10,000	55,000
No. 152, revised. Scabies of Cattle. Richard W. Hickman. 32 pp. Nov. 14, 10,000; May 28, 10,000	20,000
No. 166. Cheese Making on the Farm. Henry E. Alvord. 16 pp. Oct. 15, 10,000; Mar. 18, 10,000	20,000
No. 177, revised. Squab Raising. William E. Rice. 31 pp. Dec. 1, 10,000; May 21, 10,000	20,000
No. 179. Horseshoeing. John W. Adams. 29 pp. Sept. 12, 10,000; Mar. 3, 10,000; May 19, 10,000	30,000
No. 183, revised. Meat on the Farm: Butchering, Curing, and Keeping. Andrew Boss. 37 pp. Sept. 8, 10,000; Nov. 5, 10,000; Feb. 3, 10,000; Apr. 7, 15,000; June 1, 15,000	60,000
No. 200. Turkeys: Standard Varieties and Management. T. F. McGrew. 40 pp. July 24, 10,000; Oct. 6, 10,000; Dec. 30, 10,000; Mar. 27, 15,000; June 25, 10,000	55,000
No. 201. The Cream Separator on Western Farms. Ed. H. Webster and C. E. Gray. 23 pp. Oct. 9, 10,000; Apr. 26, 10,000	20,000
No. 205. Pig Management. George M. Rommel. 47 pp. Oct. 8, 15,000; Feb. 26, 15,000; May 20, 15,000	45,000
No. 206. Milk Fever: Its Simple and Successful Treatment. John R. Mohler. 15 pp. Nov. 16	10,000
No. 236. Incubation and Incubators. Richard H. Wood. 31 pp. Sept. 18, 10,000; Mar. 3, 10,000; May 29, 15,000	35,000
No. 241. Butter Making on the Farm. E. H. Webster. 31 pp. July 30, 10,000; Oct. 30, 15,000; Mar. 29, 10,000; June 2, 15,000	50,000
No. 258. Texas or Tick Fever and Its Prevention. John R. Mohler. 47 pp. Oct. 15, 10,000; June 10, 10,000; June 26, 10,000	30,000
No. 261. The Cattle Tick in Its Relation to Southern Agriculture. August Mayer. 24 pp. Aug. 3, 10,000; Feb. 13, 5,000; Mar. 29, 5,000	20,000
No. 287. Poultry Management. G. Arthur Bell. 48 pp. Sept. 12, 20,000; Nov. 7, 20,000; Feb. 4, 20,000; Mar. 31, 20,000; May 18, 15,000; June 24, 20,000	115,000

BUREAU OF BIOLOGICAL SURVEY.

NEW PUBLICATIONS.

Bulletin:	
No. 33. The Brown Rat in the United States. David E. Lantz. 54 pp. 15 cts. May 29	3,500
North American Fauna:	
No. 27. A Biological Investigation of the Athabaska-Mackenzie Region. Edward A. Preble. 574 pp. 80 cts. Oct. 26	1,000

Publications issued during the year ended June 30, 1909—Continued.

North American Fauna—Continued.	Copies.
No. 28. Revision of the Mice of the American Genus Peromyscus. Wilfred H. Osgood. 285 pp. 50 cts. Apr. 19	1,000
Circulars:	
No. 52, revised. Directions for Destroying Pocket Gophers. David E. Lantz. 4 pp. Sept. 11	5,000
No. 52, 2d revision. 4 pp. Oct. 29	5,000
No. 60, 2d revision. List of Publications of the Biological Survey. C. Hart Merriam. 8 pp. Nov. 17	1,000
No. 60, 3d revision. 8 pp. May 6	2,500
No. 65. Directory of Officials and Organizations Concerned with the Protection of Birds and Game, 1908. 16 pp. Aug. 18	5,000
No. 66. The Alaskan Game Law and Regulations of the Department of Agriculture, 1908. C. Hart Merriam. 8 pp. Sept. 3	5,000
No. 67. Decision of Supreme Court of the United States on the Sale of Imported Game. 12 pp. Dec. 14	5,000
No. 68. Regulation for the Protection of Deer in Alaska. C. Hart Merriam. 1 p. Mar. 6, 1,000; Mar. 9, 1,000	2,000
No. 69. Key to Animals on Which Wolf and Coyote Bounties Are Often Paid. Vernon Bailey. 3 pp. May 27	7,000
Annual Report:	
Report of the Chief of the Bureau for 1908. C. Hart Merriam. (From An. Rpts. of Dept., 1908.) 22 pp. Dec. 14	2,500
Yearbook Extracts:	
No. 443. Does it Pay the Farmer to Protect Birds? H. W. Henshaw. (From Ybk. 1907.) 16 pp. Aug. 27, 3,500; Dec. 30, 3,000	6,500
No. 452. The Rabbit as a Farm and Orchard Pest. D. E. Lantz. (From Ybk. 1907.) 15 pp. Sept. 17, 3,500; Nov. 25, 1,000; Apr. 32, 1,000	5,500
No. 462. Game Resources of Alaska. Wilfred H. Osgood. (From Ybk. 1907.) 16 pp. Aug. 24	3,500
No. 469. Game Protection in 1907. Henry Oldys. (From Ybk. 1907.) 11 pp. Aug. 15	5,000
No. 473. Bounty Laws in Force in the United States, July 1, 1907. D. E. Lantz. (From Ybk. 1907.) 7 pp. Jan. 15	300
Farmers' Bulletins:	
No. 328. Silver Fox Farming. Wilfred H. Osgood. 24 pp. Aug. 8, 15,000; Apr. 27, 5,000	20,000
No. 330. Deer Farming in the United States. D. E. Lantz. 20 pp. Aug. 6, 15,000; Oct. 29, 10,000	25,000
No. 335. Harmful and Beneficial Mammals of the Arid Interior, with Special Reference to the Carson and Humboldt Valleys, Nevada. Vernon Bailey. 31 pp. Oct. 21	20,000
No. 336. Game Laws for 1908: Provisions Relating to Seasons, Shipment, Sale, Limits, and Licenses. T. S. Palmer and Henry Oldys. 55 pp. Sept. 25, 30,000; Oct. 21, 10,000	40,000
No. 352. The Nevada Mouse Plague of 1907–8. Stanley E. Piper. 23 pp. Mar. 22, 15,000; Apr. 21, 20,000	35,000

EARLIER PUBLICATIONS REPRINTED.

Bulletin:	
No. 28. Game Commissions and Wardens: Their Appointment, Powers, and Duties. R. W. Williams, jr. 285 pp. 35 cts. Aug. 17	500
Circulars:	
No. 17. Bird Day in the Schools. 4 pp. Mar. 9	5,000
No. 61. Hawks and Owls from the Standpoint of the Farmer. A. K. Fisher. 18 pp. Dec. 14	5,000
No. 63. Destruction of Wolves and Coyotes During 1907. Vernon Bailey. 11 pp. Dec. 28	5,000
No. 64. Destruction of the Cotton Boll Weevil by Birds in Winter. Arthur H. Howell. 5 pp. Aug. 26	1,000
Yearbook Extracts:	
No. 37, Part 1. Four Common Birds of the Farm and Garden. Sylvester D. Judd. (From Ybk. 1895.) 14 pp. July 8	1,500

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Yearbook Extracts—Continued.	
No. 37, Part 2. The Meadow Lark and Baltimore Oriole. F. E. L. Beal. (From Ybk. 1895.) 12 pp. Feb. 5	3,000
No. 66. The Blue Jay and Its Food. F. E. L. Beal. (From Ybk. 1896.) 12 pp. Feb. 10	3,000
No. 194. The Food of Nestling Birds. Sylvester D. Judd. (From Ybk. 1900.) 30 pp. July 30, 1,000; May 27, 1,000	2,000
No. 322. Some New Facts about the Migration of Birds. Wells W. Cooke. (From Ybk. 1903.) 19 pp. Aug. 27, 2,000; May 22, 1,000	3,000
No. 414. Cage-Bird Traffic of the United States. Henry Oldys. (From Ybk. 1906.) 20 pp. Mar. 3	1,000
No. 416. Birds That Eat Scale Insects. W. L. McAtee. (From Ybk. 1906.) 12 pp. Feb. 11	3,000
No. 418. The Game Warden of To-Day. R. W. Williams, jr. (From Ybk. 1906.) 16 pp. Feb. 5	1,000
Farmers' Bulletins:	
No. 54, revised. Some Common Birds in Their Relation to Agriculture. F. E. L. Beal. 48 pp. Aug. 21, 10,000; Jan. 30, 10,000; May 19, 10,000	30,000
No. 197. Importation of Game Birds and Eggs for Propagation. T. S. Palmer and Henry Oldys. 30 pp. Nov. 4, 5,000; June 15, 5,000	10,000
No. 297. Methods of Destroying Rats. David E. Lantz. 8 pp. Sept. 16, 10,000; Feb. 1, 5,000; Mar. 25, 5,000	20,000

BUREAU OF CHEMISTRY.

NEW PUBLICATIONS.

Bulletins:	
No. 84. Influence of Food Preservatives and Artificial Colors on Digestion and Health. Part IV. Benzoic Acid and Benzoates. H. W. Wiley, W. D. Bigelow, F. C. Weber, and others. 258 pp. 25 cts. July 20	1,000
No. 84, Part V. Formaldehyde. 212 pp. 25 cts. Dec. 24	1,000
No. 98, revised, Part I. Drug Legislation in the United States (July 15, 1908). Lyman F. Kebler. 343 pp. 35 cts. Apr. 9	1,000
No. 107, revised. Official and Provisional Methods of Analysis of the Association of Official Agricultural Chemists. Compiled by Committee on Revision; edited by H. W. Wiley. 272 pp. 20 cts. July 29, 1,000; Oct. 5, 1,000	2,000
No. 114. Meat Extracts and Similar Preparations, Including Studies of the Methods of Analysis Employed. W. D. Bigelow and F. C. Cook. 56 pp. 10 cts. Sept. 9, 3,000; Dec. 21, 500	3,500
No. 115. A Preliminary Study of the Effects of Cold Storage on Eggs, Quail, and Chickens. H. W. Wiley, M. E. Pennington, G. W. Stiles, jr., B. J. Howard, and F. C. Cook. 117 pp. 40 cts. Nov. 23	1,000
No. 116. Proceedings of the Twenty-fourth Annual Convention of the Association of Official Agricultural Chemists, Held at Jamestown Exposition, Norfolk, Va., Oct. 9–11, 1907. Edited by H. W. Wiley. 143 pp. 20 cts. Oct. 27	1,000
No. 117. Commercial Sicilian Sumac. F. P. Veitch and B. J. Howard. 32 pp. 10 cents. Sept. 12	2,000
No. 118. Unfermented Apple Juice. H. C. Gore. 23 pp. Sept. 17	2,500
No. 119. Experiments on the Spoilage of Tomato Ketchup. A. W. Bitting. 37 pp. 10 cts. Jan. 9	2,000
No. 120. The Feeding Value of Cereals as Calculated from Chemical Analysis. Joseph S. Chamberlain. 64 pp. 10 cts. Mar. 23	2,500
No. 121. Food Legislation During the Year Ended June 30, 1908. W. D. Bigelow and N. A. Parkinson. 84 pp. 10 cts. Jan. 25	2,000
No. 122. Proceedings of the Twenty-fifth Annual Convention of the Association of Official Agricultural Chemists, Held at Washington, D. C., Nov. 12–16, 1908. Edited by H. W. Wiley. 248 pp. 40 cts. June 7	1,000

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Bulletins—Continued.	
No. 123. Metabolism of Organic and Inorganic Phosphorus: A Feeding Experiment Using Phytin and Sodium Phosphates. F. C. Cook. 63 pp. 15 cts. June 3	2,200
No. 124. Chemical Studies of American Barleys and Malts. J. A. Le Clerc and Robert Wahl. 75 pp. 20 cts. Apr. 24	2,400
No. 125. The Canning of Peas, Based on Factory Inspection and Experimental Data. A. W. Bitting. 32 pp. 10 cts. May 10	3,200
Circulars:	
No. 14, revised. Organization of the Bureau of Chemistry (Oct. 1, 1908). 27 pp. Oct. 31, 1,800; Feb. 24, 1,000	2,800
No. 16, revised. Officials Charged with the Enforcement of Food Laws in the United States and Canada (July 1, 1908). 36 pp. Oct. 27	3,000
No. 39. General Results of the Investigations Showing the Effect of Benzoic Acid and Benzoates upon Digestion and Health. 15 pp. July 20	5,000
No. 40. Methods of Analysis of Maple Products and the Detection of Adulterants. A. Hugh Bryan. 13 pp. Aug. 25, 2,000; Dec. 10, 500	2,500
No. 41. Paper Making Materials and their Conservation. F. P. Veitch. 20 pp. Jan. 2, 1,800; Mar. 31, 500	2,300
No. 42. General Results of the Investigations Showing the Effect of Formaldehyde upon Digestion and Health. 16 pp. Dec. 21, 4,000; Jan. 12, 2,000	6,000
No. 43. Extracts from Proceedings of the Association of Official Agricultural Chemists, 1908. 16 pp. Feb. 4, 1,800; Apr. 20, 500	2,300
Annual Report:	
Report of the Chemist for 1908. H. W. Wiley. (From An. Rpts. of Dept., 1908.) 54 pp. Dec. 15	1,500
Yearbook Extracts:	
No. 451. The Details of the Enforcement of the Food and Drugs Act. W. D. Bigelow. (From Ybk. 1907.) 12 pp. Aug. 6	2,000
No. 455. The Use of the Microscope in the Detection of Food Adulteration. B. J. Howard. (From Ybk. 1907.) 8 pp. Oct. 3	1,000
No. 468. Changes Taking Place in Chickens in Cold Storage. Mary E. Pennington. (From Ybk. 1907.) 14 pp. Sept. 25, 1,000; Jan. 15, 1,000	2,000
Separates from Bulletin No. 116:	
Report of Committee on Fertilizer Legislation. 4 pp. Nov. 7	100
Report on the Separation of Meat Proteids. F. C. Cook. 8 pp. Nov. 13	100
Separates from Bulletin No. 122:	
Methods of Analysis of Distilled Spirits. L. M. Tolman and W. E. Hillyer. 7 pp. June 11	100
Thomas Slag. J. B. Lindsey. 4 pp. June 11	100
The Macroscopy and Microscopy of Drugs. H. H. Rusby. 4 pp. June 11	100
The Assaying of Alkaloidal Drugs. C. E. Parker. 8 pp. June 11	100
The Necessity of Animal Experimentation in Determining the Purity and Strength of Medicinal Preparations. William Salant. 3 pp. June 11	100
Cooperative Work on Headache Mixtures. W. O. Emery. 4 pp. June 11	100
Miscellaneous Circulars:	
Yeast Cultures for Experimental Purposes. 3 pp. Aug. 11	1,000
Sugar Determination Tables. 10 pp. Nov. 14	150
Model Denatured Alcohol Distillery. H. E. Sawyer. 7 pp. Dec. 7	10,000
Farmers' Bulletins:	
No. 52, 3d revision. The Sugar Beet: Culture, Seed Development, Manufacture, and Statistics. H. W. Wiley. (Revised by A. Hugh Bryan.) 47 pp. Dec. 21	20,000
No. 359. Canning Vegetables in the Home. J. F. Breazeale. 16 pp. May 11, 20,000; June 1, 50,000; June 15, 20,000	90,000

Publications issued during the year ended June 30, 1909—Continued.

Earlier Publications Reprinted.

	Copies.
Bulletins:	
No. 84. Influence of Food Preservatives and Artificial Colors on Digestion and Health. Part III. Sulphurous Acid and Sulphites. H. W. Wiley, W. D. Bigelow, F. C. Weber, and others. 287 pp. 25 cts. Sept. 18	1,000
No. 104. Food Legislation During the Year Ended June 30, 1906. W. D. Bigelow. 53 pp. 10 cts. Sept. 9	500
No. 112. Food Legislation During the Year Ended June 30, 1907. W. D. Bigelow. Part I. Federal Laws and Laws of States and Territories—Alabama to New Hampshire. 155 pp. 20 cts. July 6	1,000
No. 112, Part II. Laws of States and Territories—New Jersey to Wyoming. 155 pp. 20 cts. July 8	1,000
Circulars:	
No. 15. Results of Borax Experiment. H. W. Wiley. 27 pp. Sept. 10	1,000
No. 19, revised. Methods for the Detection of Renovated Butter. G. E. Patrick. 6 pp. May 22	500
No. 33. Report on Methods of Beer Analysis. By H. E. Barnard. 16 pp. Apr. 8	500
No. 35. Report on Colors: The Solubility and Extraction of Colors, and the Color Reactions of Dyed Fiber and of Aqueous and Sulphuric Acid Solutions. H. M. Loomis. 51 pp. Oct. 24, 500; Feb. 8, 500	1,000
No. 37. General Results of the Investigations Showing the Effect of Sulphurous Acid and Sulphites upon Digestion and Health. 18 pp. July 7	2,000
No. 38. Extracts from Proceedings of the Association of Official Agricultural Chemists, 1907. 14 pp. Oct. 3	500
Annual Report:	
Report of the Chemist for 1907. H. W. Wiley. (From An. Rpts. of Dept., 1907.) 31 pp. July 1	1,000
Farmers' Bulletins:	
No. 131. Household Tests for the Detection of Oleomargarine and Renovated Butter. G. E. Patrick. 12 pp. July 24, 10,000; Nov. 24, 10,000	20,000
No. 135. Sorghum Sirup Manufacture. A. A. Denton. 39 pp. Mar. 22	10,000
No. 268, revised. Industrial Alcohol: Sources and Manufacture. H. W. Wiley. 47 pp. Sept. 14, 10,000; Nov. 13, 10,000; May 10, 10,000	30,000
No. 269. Industrial Alcohol: Uses and Statistics. H. W. Wiley. 31 pp. Nov. 7	10,000

BUREAU OF ENTOMOLOGY.

New Publications.

Bulletins:	
No. 66. Some Insects Injurious to Truck Crops. Part IV. The Leaf-Hoppers of the Sugar Beet and Their Relation to the "Curly-Leaf" Condition. E. D. Ball. 24 pp. 10 cts. Jan. 28	2,000
No. 66, Part V. The Semitropical Army Worm. F. H. Chittenden and H. M. Russell. 20 pp. 5 cts. Jan. 28	2,000
No. 66, Part VI. The Hop Flea-Beetle. F. H. Chittenden. 26 pp. 10 cts. May 8	2,000
No. 68. Papers on Deciduous Fruit Insects and Insecticides. Part VIII. The Grape-Leaf Skeletonizer. P. R. Jones. 16 pp. 5 cts. Jan. 20	2,000
No. 68, Part IX. The Peach-Tree Bark-Beetle. H. F. Wilson. 22 pp. 5 cts. Feb. 11	2,000
No. 75. Miscellaneous Papers on Apiculture. Part IV. The Relation of the Etiology (Cause) of Bee Diseases to the Treatment. G. F. White. 12 pp. 5 cts. Dec. 26	3,000

Publications issued during the year ended June 30, 1909—Continued.

Bulletins—Continued.	Copies.
No. 75, Part V. A Brief Survey of Hawaiian Bee Keeping. E. F. Phillips. 18 pp. 15 cts. Jan. 19	2,000
No. 75, Part VI. The Status of Apiculture in the United States. E. F. Phillips. 24 pp. 5 cts. Jan. 22	3,000
No. 75, Part VII. Bee Keeping in Massachusetts. Burton Gates. 29 pp. 5 cts. May 24	2,000
No. 76. Fumigation for the Citrus White Fly, as Adapted to Florida Conditions. A. W. Morrill. 73 pp. 15 cts. Oct. 31	3,000
No. 78. Economic Loss to the People of the United States Through Insects That Carry Disease. L. O. Howard. 40 pp. 10 cts. Mar. 19, 5,000; May 27, 3,000	8,000
No. 79. Fumigation Investigations in California. R. S. Woglum. 73 pp. 15 cts. June 11	3,000
No. 80. Papers on Deciduous Fruit Insects and Insecticides. Part I. The Codling Moth in the Ozarks. E. L. Jenne. 32 pp. 10 cts. June 28	2,000
Technical Series:	
No. 12, Part VI. A Record of Results from Rearings and Dissections of Tachinidæ. H. T. Townsend. 28 pp. Sept. 18	2,000
No. 12, Part VII. The Orange Thrips. Dudley Moulton. 6 pp. 5 cts. Feb. 11	2,000
No. 12, Part VIII. Biological Studies on Three Species of Aphididæ. John June Davis. 47 pp. 10 cts. Feb. 20	2,000
No. 16. Papers on Coccidæ, or Scale Insects. Part II. New Species of Diaspine Scale Insects. C. L. Marlatt. 32 pp. 15 cts. Aug. 6	2,000
Circulars:	
No. 5, revised. The Carpet Beetle or "Buffalo Moth." L. O. Howard. 4 pp. Aug. 12	3,000
No. 8, revised. The Imported Elm Leaf-Beetle. C. L. Marlatt. 6 pp. Sept. 22	3,000
No. 20, revised. The Woolly Aphis of the Apple. C. L. Marlatt. 6 pp. Aug. 7	4,000
No. 21, revised. The Strawberry Weevil. F. H. Chittenden. 10 pp. Sept. 19	3,000
No. 24, revised. The Two-Lined Chestnut Borer. F. H. Chittenden. 7 pp. Jan. 22	3,000
No. 31, 2d revision. The Striped Cucumber Beetle. F. H. Chittenden. 8 pp. May 27	2,000
No. 38, 2d revision. The Squash-Vine Borer. F. H. Chittenden. 6 pp. Sept. 3	3,000
No. 39, 2d revision. The Common Squash Bug. F. H. Chittenden. 5 pp. July 28	3,000
No. 42, revised. How to Control the San Jose Scale. C. L. Marlatt. 7 pp. Mar. 30	2,500
No. 43 [revised]. The Pea Aphis. F. H. Chittenden. 10 pp. Mar. 6	3,000
No. 51, revised. Cockroaches. C. L. Marlatt. 14 pp. July 16	3,000
No. 62, revised. The Cabbage Hair-Worm. F. H. Chittenden. 6 pp. July 28	3,000
No. 66, revised. The Joint-Worm. F. M. Webster. 7 pp. Sept. 21	5,000
No. 75, revised. Requirements to be Complied With by Nurserymen or Others Who Make Interstate Shipments of Nursery Stock. A. F. Burgess. 7 pp. July 24, 2,000; Oct. 6, 3,000	5,000
No. 76, revised. List of Publications of the Bureau (to May 1, 1909). 29 pp. May 19	3,000
No. 93, revised. The Spring Grain Aphis or So-called "Green Bug." F. M. Webster. 22 pp. June 23	2,000
No. 95, revised. The Most Important Step in the Control of the Boll Weevil. W. D. Hunter. 8 pp. Sept. 28, 3,000; Oct. 8, 10,000; Oct 9, 17,000	30,000
No. 95, revised. French edition. 11 pp. Jan. 21	5,000

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Circulars—Continued.	
No. 104. The Common Red Spider. F. H. Chittenden. 11 pp. Jan. 26	3,000
No. 105. The Rose Slugs. F. H. Chittenden. 12 pp. Oct. 5	3,000
No. 106. The Wheat Strawworm. F. M. Webster and Geo. I. Reeves. 16 pp. May 13	3,000
No. 107. What Can be Done in Destroying the Cotton Boll Weevil During the Winter. W. D. Hunter, 4 pp. Jan. 20	25,000
No. 108. House Fleas. L. O. Howard. 4 pp. Feb. 11	5,000
Annual Report:	
Report of the Entomologist for 1908. L. O. Howard. (From An. Rpts. of Dept., 1908.) 47 pp. Nov. 9	2,000
Yearbook Extracts:	
No. 442. Notable Depredations by Forest Insects. A. D. Hopkins. (From Ybk. 1907.) 19 pp. Aug. 5	1,500
No. 447. The Value of Insect Parasitism to the American Farmer. F. M. Webster. (From Ybk. 1907.) 24 pp. Aug. 5	1,500
No. 460. The Codling Moth or Apple Worm. A. L. Quaintance. (From Ybk. 1907.) 19 pp. Aug. 22	1,500
No. 472. Principal Injurious Insects of the Year 1907. (From Ybk. 1907.) 12 pp. Oct. 21	500
Separate from Bulletin No. 67:	
The Control of the Codling Moth in the Arid Regions. E. D. Ball. 23 pp. May 28	200
Farmers' Bulletin:	
No. 344. The Boll Weevil Problem, with Special Reference to Means of Reducing Damage. W. D. Hunter. 48 pp. Jan. 25, 30,000; Mar. 22, 20,000; May 10, 20,000	70,000
EARLIER PUBLICATIONS REPRINTED.	
Bulletins:	
No. 68. Papers on Deciduous Fruit Insect Investigations. Part I. Pear Thrips. Dudley Moulton. 20 pp. 10 cts. July 20	3,000
No. 68, Part IV. The Lesser Peach Borer. A. A. Girault. 20 pp. 5 cts. July 7	3,000
No. 69. The Chinch Bug. F. M. Webster. 95 pp. 15 cts. Dec. 16	1,000
No. 71. The Periodical Cicada. C. L. Marlatt. 181 pp. 40 cts. Aug. 31	1,000
Circulars:	
No. 13. Mosquitoes and Fleas. L. O. Howard. 4 pp. Jan. 8	500
No. 16. The Larger Corn Stalk-borer. L. O. Howard. 3 pp. June 29	3,000
No. 23. The Buffalo Tree-Hopper. C. L. Marlatt. 4 pp. Apr. 16	3,000
No. 26. The Pear Slug. C. L. Marlatt. 7 pp. Jan. 22	3,000
No. 28. The Boxelder Plant-Bug. L. O. Howard. 3 pp. June 29	3,000
No. 29, revised. The Fruit-Tree Bark-Beetle. 8 pp. Jan. 14	2,000
No. 36. The True Clothes Moths. C. L. Marlatt. 8 pp. June 16	3,000
No. 48. The House Centipede. C. L. Marlatt. 4 pp. Dec. 8	3,000
No. 54. The Peach-Tree borer. C. L. Marlatt. 6 pp. Nov. 3	2,000
No. 59. The Corn Root-worms. F. H. Chittenden. 8 pp. Jan. 30	2,000
No. 63. Root-Maggots and How to Control Them. F. H. Chittenden. 7 pp. Jan. 11	2,000
No. 68. The Tobacco Thrips, and Remedies to Prevent "White Veins" in Wrapper Tobacco. W. A. Hooker. 6 pp. July 6	3,000
No. 69. Some Insects Affecting the Production of Red Clover Seed. F. M. Webster. 9 pp. Aug. 22	5,000
No. 71, revised. House Flies. L. O. Howard. 10 pp. Nov. 18	5,000
No. 80. The Melon Aphis. F. H. Chittenden. 16 pp. Sept. 10	3,000
No. 83. The Locust Borer and Methods for Its Control. A. D. Hopkins. 8 pp. Nov. 25	3,000
No. 87. The Colorado Potato Beetle. F. H. Chittenden. 15 pp. June 14	3,000
No. 94. The Cause of American Foul Brood. G. F. White. 4 pp. June 7	3,000
No. 98. The Apple Tree Tent Caterpillar. A. L. Quaintance. 8 pp. Nov. 18	3,000

Publications issued during the year ended June 30, 1909—Continued.

Circulars—Continued.	Copies.
No. 99. The Nut Weevils. F. H. Chittenden. 15 pp. Dec. 28	3,000
No. 101. The Apple Maggot or "Railroad Worm." A. L. Quaintance. 12 pp. June 21	3,000
Yearbook Extracts:	
No. 196. Smyrna Fig Culture in the United States. L. O. Howard. (From Ybk. 1900.) 32 pp. Feb. 6	1,000
No. 248. Experimental Work with Fungous Diseases of Grasshoppers. L. O. Howard. (From Ybk. 1901.) 16 pp. Dec. 8	500
No. 261. The San Jose Scale: Its Native Home and Natural Enemy. C. L. Marlatt. (From Ybk. 1902.) 24 pp. Jan. 16	500
No. 268. Some of the Principal Insect Enemies of Coniferous Forests in the United States. A. D. Hopkins. (From Ybk. 1902.) 24 pp. Dec. 28	500
No. 327. Insect Injuries to Hardwood Forest Trees. A. D. Hopkins. (From Ybk. 1903.) 20 pp. July 7	1,000
Separate from Bulletin No. 61:	
State and Territorial Laws Relative to Foul Brood. 17 pp. Aug. 5	500
Farmers' Bulletins:	
No. 47. Insects Affecting the Cotton Plant. L. O. Howard. 31 pp. Sept. 23, 10,000; June 5, 10,000	20,000
No. 59, revised. Bee Keeping. Frank Benton. 47 pp. Sept. 17, 10,000; Feb. 1, 10,000; May 5, 10,000	30,000
No. 80. The Peach Twig-borer: An Important Enemy of Stone Fruits. C. L. Marlatt. 15 pp. Nov. 7, 5,000; Apr. 26, 5,000	10,000
No. 99. Three Insect Enemies of Shade Trees. L. O. Howard. 31 pp. July 13, 10,000; Apr. 17, 10,000	20,000
No. 120. Principal Insects Affecting the Tobacco Plant. L. O. Howard. 32 pp. May 6	10,000
No. 127, 2d revision. Important Insecticides: Directions for Their Preparation and Use. C. L. Marlatt. 48 pp. Apr. 5	5,000
No. 132. The Principal Insect Enemies of Growing Wheat. C. L. Marlatt. 40 pp. Dec. 28	10,000
No. 145. Carbon Bisulphid as an Insecticide. W. E. Hinds. 30 pp. May 17	10,000
No. 155, revised. How Insects Affect Health in Rural Districts. L. O. Howard. 19 pp. July 18, 10,000; Feb. 9, 5,000; May 18, 10,000	25,000
No. 165, revised. Silkworm Culture. Henrietta A. Kelly. (Revised by C. J. Gilliss.) 32 pp. Mar. 18	5,000
No. 172. Scale Insects and Mites on Citrus Trees. C. L. Marlatt. 44 pp. Nov. 14, 5,000; May 27, 5,000	10,000
No. 178. Insects Injurious in Cranberry Culture. John B. Smith. 31 pp. May 26	5,000
No. 196. Usefulness of the American Toad. A. H. Kirkland. 16 pp. Sept. 11, 5,000; Feb. 9, 5,000; June 1, 5,000; June 19, 5,000	20,000
No. 209. Controlling the Boll Weevil in Cotton Seed and at Ginneries. W. D. Hunter. 31 pp. Sept. 24, 10,000; May 29, 10,000	20,000
No. 211. The Use of Paris Green in Controlling the Cotton Boll Weevil. W. D. Hunter. 24 pp. Sept. 21, 10,000; May 26, 10,000	20,000
No. 223. Miscellaneous Cotton Insects in Texas. E. Dwight Sanderson. 23 pp. Sept. 23	10,000
No. 264. The Brown-Tail Moth and How to Control It. L. O. Howard. 24 pp. Aug. 8, 10,000; Sept. 25, 5,000	15,000
No. 275. The Gypsy Moth and How to Control It. L. O. Howard. 24 pp. Apr. 27	5,000
No. 284. Insect and Fungous Enemies of the Grape East of the Rocky Mountains. A. L. Quaintance and C. L. Shear. 48 pp. Oct. 16, 10,000; June 10, 10,000	20,000
No. 290. The Cotton Bollworm. F. C. Bishop and C. R. Jones. 32 pp. July 30, 10,000; Apr. 23, 5,000	15,000

Publications issued during the year ended June 30, 1909—Continued.

OFFICE OF EXPERIMENT STATIONS.

NEW PUBLICATIONS.

Bulletins:	Copies.
No. 200. Course in Cereal Foods and Their Preparation, for Movable Schools of Agriculture. Margaret J. Mitchell. 78 pp. 10 cts. July 27	5,000
No. 201. Cost of Pumping from Wells for the Irrigation of Rice in Louisiana and Arkansas. W. B. Gregory. 39 pp. 10 cts. Oct. 30	3,000
No. 202. Digestibility of Starch of Different Sorts as Affected by Cooking. Edna B. Day. 41 pp. 10 cts. Dec. 17, 2,500; Jan. 4, 200	2,700
No. 203. Distribution of Water in the Soil in Furrow Irrigation. R. H. Loughridge. 63 pp. 10 cts. Dec. 21	2,500
No. 204. School Gardening and Nature Study in English Rural Schools and in London. Susan B. Sipe. 37 pp. 10 cts. Feb. 25	6,100
No. 205. Irrigation in Wyoming. Clarence T. Johnston. 60 pp. 15 cts. Jan. 13	5,000
No. 206. Organization Lists of the Agricultural Colleges and Experiment Stations in the United States, December, 1908. 114 pp. 15 cts. Jan. 30	3,000
No. 207. Irrigation in the Sacramento Valley, California. Samuel Fortier. 99 pp. 15 cts. Mar. 16	3,500
No. 208. Influence of Muscular and Mental Work on Metabolism and the Efficiency of the Human Body as a Machine. Francis G. Benedict and Thorne M. Carpenter. 100 pp. 15 cts. Apr. 19	1,250
No. 209. Irrigation in Oregon. John H. Lewis and Percy A. Cupper. 67 pp. 15 cts. Apr. 27	5,000
No. 210. Irrigation in South Dakota. Samuel H. Lea. 60 pp. 10 cts. Apr. 20	5,000
No. 211. Irrigation in Kansas. Don H. Bark. 28 pp. 10 cts. May 15	5,000
No. 214. Irrigation in the State of Washington. O. L. Waller. 64 pp. 10 cts. June 22	5,000
No. 215. Irrigation in New Mexico. Vernon L. Sullivan. 42 pp. 15 cts. June 25	5,000
Bulletin of Hawaii Station:	
No. 16. The Ceara Rubber Tree in Hawaii. Jared G. Smith and Q. Q. Bradford. 30 pp. 10 cts. July 3	4,500
Bulletin of Porto Rico Station:	
No. 8. Pineapple Growing in Porto Rico. H. C. Henricksen and M. J. Iorns. 42 pp. 15 cts. Apr. 6	3,000
Circulars:	
No. 23, revised. Key to Subject Index of Experiment Station Literature. 4 pp. Feb. 16	500
No. 47, revised. Card Index of Experiment Station Literature. 2 pp. Aug. 7, 400; Dec. 7, 500; Feb. 20, 500	1,400
No. 51, revised. List of State Directors of Farmers' Institutes and Farmers' Institute Lecturers in the United States. 32 pp. Jan. 2	2,500
No. 68, revised. Federal Legislation, Regulations, and Rulings Affecting Agricultural Colleges and Experiment Stations. 21 pp. Sept. 21, 1,000; June 15, 3,000	4,000
No. 70, revised. Publications of the Office of Experiment Stations from Its Organization to June 30, 1908. 19 pp. Sept. 21	1,500
No. 79. Form of Organization for Movable Schools of Agriculture. 8 pp. Oct. 24, 8,500; Dec. 8, 3,000; Apr. 17, 1,000	12,500
No. 80. Report on Drainage of Agricultural Lands in the Kankakee River Valley, Indiana. W. D. Pence and Morton H. Downey. 23 pp. Feb. 4	3,000
No. 81. Report on Drainage of Agricultural Lands in Bolivar County, Mississippi. W. J. McEathron and S. H. McCrory. 28 pp. Jan. 28	2,000

Publications issued during the year ended June 30, 1909—Continued.

Circulars—Continued.	Copies.
No. 82. Report of Committee on Station Organization and Policy. 10 pp. Dec. 18	3,500
No. 83. The American System of Agricultural Education. A. C. True and Dick J. Crosby. 27 pp. May 27	5,000
Experiment Station Record[a] (a monthly review devoted mainly to the work of the State Agricultural Experiment Stations):	
Vol. XIX, No. 10, June, 1908. 110 pp. July 13	7,500
Vol. XIX, No. 11, July, 1908. 110 pp. Aug. 22	7,500
Vol. XIX, No. 12, August, 1908. 110 pp. Sept. 4	7,500
Vol. XIX, Name Index. 43 pp. Oct. 29	7,500
Vol. XIX, Subject Index. 92 pp. Nov. 6	7,500
Vol. XX, No. 1, September, 1908. 110 pp. Oct. 20	7,500
Vol. XX, No. 2, October, 1908. 110 pp. Nov. 13	7,500
Vol. XX, No. 3, November, 1908. 108 pp. Dec. 19	7,500
Vol. XX, No. 4, December, 1908. 110 pp. Jan. 9	7,500
Vol. XX, No. 5, January, 1909. 108 pp. Feb. 6	7,500
Vol. XX, No. 6, February, 1909. 110 pp. Mar. 11	7,500
Vol. XX, No. 7, March, 1909. 110 pp. Apr. 10	7,500
Vol. XX, No. 8, March, 1909 (abstract number). 110 pp. Apr. 22	7,500
Vol. XX, No. 9, April, 1909. 110 pp. May 14	7,500
Vol. XX, No. 10, May, 1909. 110 pp. May 26	7,500
Vol. XX, No. 11, June, 1909. 110 pp. June 18	7,500
Annual Report:	
Report of the Director of the Office of Experiment Stations for 1908. A. C. True. (From An. Rpts. of Dept., 1908.) 29 pp. Dec. 7	2,500
Farmers' Institute Lecture:	
No. 10. Syllabus of Illustrated Lecture on the Production and Marketing of Eggs and Fowls. James Dryden. 20 pp. Jan. 25	3,000
Yearbook Extracts:	
No. 445. Training Courses for Teachers of Agriculture. Dick J. Crosby. (From Ybk. 1907.) 16 pp. Aug. 15	5,000
No. 454. Food and Diet in the United States. C. F. Langworthy. (From Ybk. 1907.) 20 pp. Aug. 12	3,000
No. 458. The Use of Small Water Supplies for Irrigation. Samuel Fortier. (From Ybk. 1907.) 20 pp. Aug. 5, 2,000; Apr. 26, 1,000	3,000
Experiment Station Work (compiled from the publications of the State Experiment Stations):	
Vol. III, No. 7. 32 pp. Sept. 22	3,000
Vol. III, No. 8. 32 pp. Oct. 26	3,500
Vol. III, No. 9. 31 pp. Jan. 29	3,500
Vol. III, No. 10. 32 pp. Apr. 28	3,500
Vol. III, No. 11. 32 pp. June 23	3,500
Separates from Annual Report, Office of Experiment Stations, 1907:	
Drainage Investigations, 1907–8. C. G. Elliott. 8 pp. Jan. 2	1,000
Work and Expenditures of the Agricultural Experiment Stations for the year ended June 30, 1907. 45 pp. Dec. 14	1,000
Statistics of Land-Grant Colleges and Agricultural Experiment Stations, 1907. M. T. Spethmann. 39 pp. Dec. 5	500
Progress in Agricultural Education, 1907. Dick J. Crosby. 75 pp. Dec. 8, 1,000; Jan. 12, 4,000	5,000
The Farmers' Institutes in the United States, 1907. John Hamilton. 51 pp. Nov. 17	3,500
Relation of Nutrition Investigations to Questions of Home Management. C. F. Langworthy. 15 pp. Dec. 7	1,000
Losses of Irrigation Water and Their Prevention. R. P. Teele. 21 pp. Dec. 5, 1,000; Apr. 26, 1,000	2,000
Progress in Drainage. C. G. Elliott. 21 pp. Dec. 14, 1,000; May 1, 1,000	2,000
Agriculture in Guam. 12 pp. Dec. 1	500

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[a] Price per volume of 12 numbers with indexes, $1.50, payable in advance; no single copies sold. Beginning with July, 1909, two volumes of about 8 numbers each will be issued within the year, and the price for these will be $1 per volume.

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Separate from Annual Report of Alaska Station, 1907:	
Dairy Practice at Kenai Station. P. H. Ross. 13 pp. July 10	2,000
Lists of Station Publications Received during—	
June, 1908. 6 pp. July 13	4,250
July, 1908. 8 pp. Aug. 10	4,250
August, 1908. 8 pp. Sept. 12	5,000
September, 1908. 4 pp. Oct. 12	3,750
October, 1908. 6 pp. Nov. 12	4,500
November, 1908. 5 pp. Dec. 10	4,500
December, 1908. 4 pp. Jan. 13	4,500
January, 1909. 6 pp. Feb. 11	4,500
February, 1909. 5 pp. Mar. 19	4,500
March, 1909. 7 pp. Apr. 12	4,500
April, 1909. 6 pp. May 17	4,500
May, 1909. 6 pp. June 12	4,500
Miscellaneous Circulars:	
List of Publications of the Office of Experiment Stations on Agricultural Education (revised to October 1, 1908). 13 pp. Oct. 27	2,000
Institutions in the United States Giving Instruction in Agricultural Education. 10 pp. Oct. 17, 3,000; Jan. 9, 300	3,300
Organization and Work of the Office of Experiment Stations. 32 pp. June 7	3,000
Constitution and By-Laws of the American Association of Farmers' Institute Workers. 4 pp. June 12	1,000
Address List of Agricultural Experiment Stations in the United States (revised). 1 p. Oct. 1, 500; Mar. 11, 500	1,000
Address List of Agricultural and Mechanical Colleges in the United States (revised). 2 pp. Oct. 2, 500; Mar. 16, 500	1,000
Farmers' Bulletins:	
No. 329. Experiment Station Work, XLVII. 32 pp. Aug. 14	30,000
No. 332. Nuts and Their Uses as Food. M. E. Jaffa. 28 pp. Oct. 26, 15,000; Feb. 8, 10,000; May 29, 15,000	40,000
No. 334. Experiment Station Work, XLVIII. 32 pp. Oct. 5, 20,000; Feb. 2, 10,000; June 15, 10,000	40,000
No. 342. Experiment Station Work, XLIX. 32 pp. Jan. 11, 30,000; June 2, 15,000	45,000
No. 353. Experiment Station Work, L. 32 pp. Apr. 12	30,000
No. 360. Experiment Station Work, LI. 32 pp. June 14	15,000

EARLIER PUBLICATIONS REPRINTED.

Bulletins:	
No. 32. Dietary Studies at Purdue University in 1895. W. E. Stone. 28 pp. 5 cts. Jan. 9	200
No. 35. Food and Nutrition Investigations in New Jersey. E. B. Voorhees. 40 pp. 5 cts. Dec. 30	200
No. 44. Report of Preliminary Investigations on the Metabolism of Nitrogen and Carbon in the Human Organism with a Respiration Calorimeter of Special Construction. W. O. Atwater, C. D. Woods, and T. G. Benedict. 64 pp. 5 cts. Jan. 11	200
No. 66. The Physiological Effect of Creatin and Creatinin and Their Value as Nutrients. J. W. Mallet. 24 pp. 5 cts. Jan. 9	300
No. 89. Experiments on the Effect of Muscular Work on the Digestibility of Food and the Metabolism of Nitrogen, at the University of Tennessee, 1897–99. Chas. E. Wait. 77 pp. 5 cts. Jan. 11	200
No. 98. Effect of Severe and Prolonged Muscular Work on Food Consumption, Digestion, and Metabolism. W. O. Atwater and H. C. Sherman. The Mechanical Work and Efficiency of Bicyclers. 67 pp. 5 cts. Dec. 30	200
No. 101. Studies on Bread and Bread Making at the University of Minnesota in 1899 and 1900. Harry Snyder. 65 pp. 10 cts. Aug. 21	500
No. 103. The Evolution of Reaping Machines. Merritt F. Miller. 43 pp. 11 cts. Jan. 11	200

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Bulletins—Continued.	
No. 117. Experiments on Effect of Muscular Work on Digestibility of Food and Metabolism of Nitrogen, at the University of Tennessee. Chas. E. Wait. 43 pp. 5 cts. Jan. 11	200
No. 146. Current Wheels: Their Use in Lifting Water for Irrigation. 38 pp. 10 cts. Aug. 12	500
No. 178. Course in Fruit Growing for Movable Schools of Agriculture. Samuel B. Green. 100 pp. 15 cts. July 21	1,000
No. 186. Exercises in Elementary Agriculture. Plant Production. Dick J. Crosby. 64 pp. 10 cts. Aug. 8	5,000
No. 196. Proceedings of the 21st Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, Lansing, Mich., May 28–30, 1907. Edited by A. C. True, W. H. Beal, and H. C. White. 114 pp. 15 cts. Sept. 9	500
Circulars:	
No. 32. Report of Committee on Methods of Teaching Agriculture. 20 pp. Dec. 18	100
No. 60. The Teaching of Agriculture in the Rural Common Schools. 20 pp. Aug. 6	3,000
No. 72. Report of Committee on Extension Work. 8 pp. July 13	1,500
No. 75. Report of Committee on Extension Work, 1906–7. 20 pp. Dec. 18	1,000
Experiment Station Record:	
Vol. XIX, No. 2, Oct., 1907. 110 pp. Jan. 8	500
Vol. XIX, No. 5, Jan., 1908. 110 pp. Jan. 8	500
Vol. XIX, No. 8, Apr., 1908. 110 pp. July 29	500
Vol. XIX, No. 9, May, 1908. 108 pp. July 29	500
Yearbook Extracts:	
No. 280. The Cost of Food as Related to Its Nutritive Value. R. D. Milner. (From Ybk. 1902.) 22 pp. Nov. 14, 200; Dec. 18, 200	400
No. 285. Progress in Secondary Education in Agriculture. A. C. True. (From Ybk. 1902.) 23 pp. July 1, 200; Oct. 29, 500	700
No. 362. Boys' Agricultural Clubs. Dick J. Crosby. (From Ybk. 1904.) 13 pp. Aug. 13, 1,000; Feb. 8, 1,000; May 15, 1,000	3,000
No. 382. The Use of Illustrative Material in Teaching Agriculture in Rural Schools. Dick J. Crosby. (From Ybk. 1905.) 20 pp. Aug. 25	1,000
No. 423. Corn-Breeding Work at the Experiment Stations. J. J. Schulte. (From Ybk. 1906.) 19 pp. Aug. 21	500
Separates from Bulletin No. 158:	
No. 6. Irrigation in Southern Texas. Aug. J. Bowie, jr. 165 pp. Aug. 25	1,000
Report of Drainage Investigations, 1904. C. G. Elliott. 106 pp. Dec. 23	2,000
Separate from Bulletin No. 164:	
Courses in Agriculture, Horticulture, and Allied Subjects. F. W. Rane. 14 pp. Oct. 29, 500; Apr. 17, 500	1,000
Miscellaneous Circulars, etc.:	
Organization, Work, and Publications of Irrigation Investigations. 11 pp. Aug. 10	2,000
List of Station Publications Received During May, 1908. 5 pp. Oct. 22	500
Swamp Lands of the United States. Letter of the Secretary of Agriculture Transmitting Information. 18 pp. (S. Doc. 443, 60th Cong., 1st sess.) Aug. 28	500
Farmers' Bulletins:	
No. 22, 2d revision. Feeding Farm Animals. E. W. Allen. 39 pp. July 11, 10,000; Aug. 8, 10,000; Oct. 14, 15,000; Oct. 23, 10,000; Nov. 13, 15,000; Apr. 6, 15,000; June 11, 15,000	90,000
No. 32, revised. Silos and Silage. Chas. S. Plumb. 32 pp. Oct. 30, 10,000; Mar. 10, 10,000; June 8, 10,000	30,000
No. 34. Meats: Composition and Cooking. Chas. D. Woods. 31 pp. Oct. 5, 10,000; Nov. 4, 10,000; Apr. 17, 10,000; June 28, 5,000	35,000

Publications issued during the year ended June 30, 1909—Continued.

Farmers' Bulletins—Continued.	Copies.
No. 35. Potato Culture. F. J. Duggar. 23 pp. July 30, 10,000; Oct. 9, 10,000; Dec. 30, 10,000; Mar. 16, 10,000; May 21, 15,000	55, 000
No. 44, revised. Commercial Fertilizers: Composition and Use. E. B. Voorhees. 40 pp. July 31, 10,000; Oct. 26, 10,000; Mar. 25, 10,000; May 27, 10,000	40, 000
No. 48. The Manuring of Cotton. 16 pp. Aug. 21, 10,000; May 29, 10,000	20, 000
No. 49. Sheep Feeding. John A. Craig. 30 pp. Mar. 10	10, 000
No. 56. Experiment Station Work, I. 32 pp. July 21, 10,000; Apr. 8, 10,000	20, 000
No. 65. Experiment Station Work, II. 32 pp. Sept. 11, 5,000; Mar. 10, 10,000	15, 000
No. 69. Experiment Station Work, III. 32 pp. Mar. 31	10, 000
No. 73. Experiment Station Work, IV. 31 pp. Apr. 27	10, 000
No. 74. Milk as Food. 40 pp. Oct. 8, 10,000; Feb. 8, 10,000; May 15, 10,000	30, 000
No. 77, revised. The Liming of Soils. H. J. Wheeler. 23 pp. July 29, 10,000; Feb. 5, 10,000; June 11, 10,000	30, 000
No. 78. Experiment Station Work, V. 31 pp. Aug. 29, 10,000; May 29, 10,000	20, 000
No. 79. Experiment Station Work, VI. 30 pp. Sept. 18, 5,000; Apr. 8, 5,000	10, 000
No. 81. Corn Culture in the South. S. M. Tracy. 24 pp. July 23, 10,000; Oct. 29, 10,000; Mar. 10, 10,000; May 26, 10,000	40, 000
No. 84. Experiment Station Work, VII. 31 pp. Sept. 21, 5,000; Dec. 2, 10,000	15, 000
No. 85, revised. Fish as Food. C. F. Langworthy. 32 pp. Aug. 10, 10,000; Nov. 21, 10,000; Apr. 26, 5,000	25, 000
No. 87. Experiment Station Work, VIII. 32 pp. July 29, 10,000; June 15, 5,000	15, 000
No. 92. Experiment Station Work, IX. 32 pp. Sept. 21	5, 000
No. 93, revised. Sugar as Food. Mary Abel Hinman. 31 pp. Sept. 8, 10,000; Nov. 4, 10,000; May 19, 10,000	30, 000
No. 97. Experiment Station Work, X. 31 pp. Aug. 1, 10,000; Apr. 6, 10,000	20, 000
No. 103. Experiment Station Work, XI. 32 pp. Sept. 21, 5,000; May 19, 10,000	15, 000
No. 105. Experiment Station Work, XII. 31 pp. Apr. 15	5, 000
No. 107. Experiment Station Work, XIII. 32 pp. Nov. 6, 5,000; June 15, 10,000	15, 000
No. 112. Bread and the Principles of Bread Making. Helen W. Atwater. 40 pp. Sept. 4, 10,000; Nov. 6, 10,000; Jan. 27, 10,000; May 1, 10,000	40, 000
No. 114. Experiment Station Work, XIV. 30 pp. Mar. 29	10, 000
No. 116. Irrigation in Fruit Growing. E. J. Wickson. 48 pp. Oct. 17, 10,000; Apr. 17, 5,000	15, 000
No. 119. Experiment Station Work, XV. 32 pp. Mar. 25	10, 000
No. 121, revised. Beans, Peas, and Other Legumes as Food. Mary Hinman Abel. 40 pp. July 16, 10,000; Nov. 4, 10,000; Apr. 9, 10,000	30, 000
No. 122. Experiment Station Work, XVI. 31 pp. Sept. 11, 10,000; June 15, 10,000	20, 000
No. 124. Experiment Station Work, XVII. 32 pp. Mar. 22	10, 000
No. 128, revised. Eggs and Their Uses as Food. C. F. Langworthy. 40 pp. July 11, 10,000; Oct. 5, 10,000; Jan. 21, 10,000; Apr. 22, 15,000	45, 000
No. 133. Experiment Station Work, XVIII. 32 pp. Aug. 4, 10,000; Mar. 10, 5,000	15, 000
No. 138. Irrigation in Field and Garden. E. J. Wickson. 40 pp. July 24, 10,000; Nov. 14, 10,000; May 22, 10,000	30, 000
No. 142. Principles of Nutrition and Nutritive Value of Food. W. O. Atwater. 48 pp. Oct. 9, 10,000; Feb. 26, 10,000; May 10, 10,000	30, 000
No. 149. Experiment Station Work, XX. 31 pp. Jan. 28, 5,000; May 29, 10,000; June 15, 10,000	25, 000

Publications issued during the year ended June 30, 1909—Continued.

Farmers' Bulletins—Continued.	Copies.
No. 158. How to Build Small Irrigation Ditches. C. T. Johnston and J. D. Stannard. 30 pp. Dec. 4, 10,000; Apr. 27, 15,000	25,000
No. 162. Experiment Station Work, XXI. 32 pp. Apr. 29	10,000
No. 169. Experiment Station Work, XXII. 32 pp. Mar. 15	10,000
No. 170. Principles of Horse Feeding. C. F. Langworthy. 45 pp. July 22, 10,000; Oct. 20, 25,000; Mar. 18, 15,000; May 22, 10,000	60,000
No. 182. Poultry as Food. Helen W. Atwater. 39 pp. Oct. 9, 10,000; Jan. 9, 10,000; Apr. 10, 15,000	35,000
No. 186. Experiment Station Work, XXIII. 32 pp. Nov. 14, 10,000; June 11, 10,000	20,000
No. 187. Drainage of Farm Lands. C. G. Elliott. 40 pp. Oct. 13, 10,000; Mar. 29, 10,000; June 30, 10,000	30,000
No. 190. Experiment Station Work, XXIV. 32 pp. Feb. 8	10,000
No. 192. Barnyard Manure. W. H. Beal. 32 pp. Nov. 21, 10,000; Mar. 31, 15,000	25,000
No. 193. Experiment Station Work, XXV. 32 pp. Apr. 20	10,000
No. 202. Experiment Station Work, XXVI. 32 pp. Aug. 7, 10,000; May 21, 5,000	15,000
No. 203. Canned Fruit, Preserves, and Jellies: Household Methods of Preparation. Maria Parloa. 31 pp. July 24, 15,000; Sept. 18, 10,000; Oct. 9, 10,000; Feb. 25, 10,000; May 18, 10,000	55,000
No. 210. Experiment Station Work, XXVII. 32 pp. May 18	10,000
No. 222. Experiment Station Work, XXVIII. 32 pp. Aug. 1	10,000
No. 225. Experiment Station Work, XXIX. 32 pp. Nov. 14, 10,000; Apr. 24, 10,000	20,000
No. 227. Experiment Station Work, XXX. 32 pp. Sept. 1, 10,000; June 12, 10,000	20,000
No. 233. Experiment Station Work, XXXI. 32 pp. July 27, 10,000; May 26, 10,000	20,000
No. 234. The Guinea Fowl and Its Use as Food. C. F. Langworthy. 24 pp. July 23, 10,000; Apr. 15, 10,000	20,000
No. 237. Experiment Station Work, XXXII. 32 pp. July 24, 10,000; Mar. 22, 10,000	20,000
No. 244. Experiment Station Work, XXXIII. 32 pp. Nov. 16	10,000
No. 249. Cereal Breakfast Foods. Charles D. Woods. 38 pp. July 29, 10,000; Nov. 12, 10,000; Apr. 20, 15,000	35,000
No. 251. Experiment Station Work, XXXIV. 32 pp. Nov. 6	10,000
No. 256. Preparation of Vegetables for the Table. Maria Parloa. 48 pp. Aug. 8, 10,000; Aug. 21, 20,000; Oct. 9, 15,000; Apr. 12, 10,000; June 18, 20,000	75,000
No. 259. Experiment Station Work, XXXV. 32 pp. Sept. 23	10,000
No. 262. Experiment Station Work, XXXVI. 32 pp. Nov. 16	10,000
No. 263. Practical Information for Beginners in Irrigation. S. Fortier. 40 pp. Sept. 3, 10,000; Apr. 2, 10,000	20,000
No. 267. Experiment Station Work, XXXVII. 32 pp. Aug. 8, 10,000; May 29, 10,000	20,000
No. 270. Modern Conveniences for the Farm Home. Elmina T. Wilson. 48 pp. July 10, 10,000; Sept. 17, 15,000; Nov. 2, 15,000; Feb. 5, 10,000; Apr. 27, 10,000; June 10, 15,000	75,000
No. 273. Experiment Station Work, XXXVIII. 32 pp. Sept. 21, 10,000; Nov. 10, 10,000	20,000
No. 276. Experiment Station Work, XXXIX. 32 pp. June 17	10,000
No. 277. The Use of Alcohol and Gasoline in Farm Engines. Chas. E. Lucke and S. M. Woodward. 40 pp. Oct. 13, 10,000; Apr. 19, 10,000	20,000
No. 281. Experiment Station Work, XL. 32 pp. Nov. 4, 10,000; Feb. 19, 20,000	30,000
No. 293. Use of Fruit as Food. C. F. Langworthy. 40 pp. Sept. 4, 15,000; Mar. 26, 15,000	30,000
No. 295. Potatoes and Other Root Crops as Food. C. F. Langworthy. 48 pp. Oct. 2, 15,000; Feb. 17, 10,000; Apr. 24, 15,000	40,000
No. 296. Experiment Station Work, XLI. 32 pp. July 27, 10,000; Aug. 13, 10,000; June 2, 10,000	30,000

Publications issued during the year ended June 30, 1909—Continued.

Farmers' Bulletins—Continued.	Copies.
No. 298. Food Value of Corn and Corn Products. Chas. D. Woods. 40 pp. Aug. 1, 15,000; Feb. 6, 15,000; June 10, 15,000	45,000
No. 303. Corn-Harvesting Machinery. C. J. Zintheo. 32 pp. Sept. 4, 10,000; Nov. 16, 15,000; May 10, 15,000	40,000
No. 305. Experiment Station Work, XLII. 32 pp. Nov. 7, 10,000; May 29, 10,000	20,000
No. 309. Experiment Station Work, XLIII. 32 pp. July 23, 10,000; Mar. 10, 10,000	20,000
No. 316. Experiment Station Work, XLIV. 32 pp. Sept. 10, 15,000; June 22, 10,000	25,000
No. 317. Experiment Station Work, XLV. 32 pp. July 11, 10,000; Sept. 17, 15,000; Oct. 14, 15,000; June 16, 10,000	50,000
No. 320. Experiment Station Work, XLVI. 32 pp. Oct. 2, 10,000; June 19, 10,000	20,000

FOREST SERVICE.

New Publications.

Circulars:	
No. 21, 6th revision. Practical Assistance to Farmers, Lumbermen, and other Owners of Forest Lands. 5 pp. Apr. 13	500
No. 23, 4th revision. Suggestions to Prospective Forest Students. 2 pp. Nov. 6, 2,000; Jan. 27, 5,000	7,000
No. 38, revised. Instructions to Engineers of Timber Tests. 56 pp. Mar. 31	4,000
No. 58, revised. Forest Planting Leaflet. Red Oak. 2 pp. Mar. 23	2,000
No. 63, revised. Forest Planting Leaflet. Basswood. 3 pp. Mar. 23	500
No. 64, revised. Forest Planting Leaflet. Black Locust. 4 pp. Feb. 15	3,000
No. 86, revised. Forest Planting Leaflet. Boxelder. 3 pp. Mar. 23	1,000
No. 130, revised. Forestry in the Public Schools. Hugo A. Winkenwerder. 20 pp. Oct. 29	15,000
No. 135. The Chestnut Oak in the Southern Appalachians. H. D. Foster and W. W. Ashe. 23 pp. Sept. 1	20,000
No. 150. Douglas Fir: A Study of the Pacific Coast and Rocky Mountain Forms. E. H. Frothingham. 38 pp. Jan. 22	13,000
No. 151. The Preservative Treatment of Loblolly Pine Cross-Arms. W. F. Sherfesee. 29 pp. July 31, 28,000; Oct. 29, 1,000	29,000
No. 152. The Analysis of Turpentine by Fractional Distillation with Steam. William C. Geer. 29 pp. Sept. 22	23,000
No. 153. Exports and Imports of Forest Products, 1907. A. H. Pierson. 26 pp. Sept. 1	5,500
No. 154. Native and Planted Timber of Iowa. Hugh P. Baker. 24 pp. Sept. 14, 31,000; May 3, 1,000	32,000
No. 155. Production and Consumption of Basket Willows in the United States for 1906 and 1907. C. D. Mell. 14 pp. Jan. 28	10,000
No. 156. Preliminary Report on Grazing Experiments in a Coyote-Proof Pasture. James F. Jardine. (Introduction by F. V. Coville.) 32 pp. Dec. 23	46,000
No. 157. A Primer of Conservation. Treadwell Cleveland, jr. 24 pp. Oct. 17	100,000
No. 158. The Revegetation of Over-grazed Range Areas. Arthur W. Sampson. (Introduction by F. V. Coville.) 21 pp. Dec. 8	31,000
No. 159. The Future Use of Land in the United States. Raphael Zon. 15 pp. Jan. 22, 62,000; Apr. 20, 500	62,500
No. 161. Forest Planting in Western Kansas. R. S. Kellogg. 51 pp. Mar. 2	6,000
No. 162. Exports and Imports of Forest Products, 1908. A. H. Pierson. 29 pp. May 10	6,000
No. 165. Practical Assistance to Owners of Forest Land and to Tree Planters. 7 pp. June 18	4,000

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Annual Report:	
Report of the Forester for 1908. Gifford Pinchot. (From An. Rpts. of Dept. 1908.) 44 pp. Jan. 2	2,500
Yearbook Extracts:	
No. 466. Cutting Timber on the National Forests and Providing for a Future Supply. Raphael Zon and E. H. Clapp. (From Ybk. 1907.) 14 pp. Sept. 16	10,000
No. 470. Progress of Forestry in 1907 (by Q. R. Craft), and Directory of Forest Officers, Associations and Schools. (From Ybk. 1907.) 19 pp. Oct. 29	10,000
Silvical Leaflets:	
No. 12, revised. Yellow Cedar (*Chamæcyparis nootkatensis*). 4 pp. Sept. 24	8,000
No. 15. White Spruce (*Picea canadensis*). 2 pp. Oct. 15	8,000
No. 16. Single-leaf Piñon (*Pinus monophylla*). 2 pp. Oct. 7	8,000
No. 17. Four-leaf Piñon (*Pinus quadrifolia*). 2 pp. Oct. 7	8,000
No. 18. Redwood (*Sequoia sempervirens*). 5 pp. Oct. 29	8,000
No. 19. Bigtree (*Sequoia washingtoniana*). 5 pp. Oct. 29	8,000
No. 20. Weeping Spruce (*Picea breweriana*). 2 pp. Oct. 2	8,000
No. 21. Jeffrey Pine (*Pinus jeffreyi*). 3 pp. Nov. 16	8,000
No. 22. Amabilis Fir (*Abies amabilis*). 3 pp. Oct. 2	8,000
No. 23. Bristle-cone Pine (*Pinus aristata*). 2 pp. Oct. 28	8,000
No. 24. Bristle-cone Fir (*Abies venusta*). 2 pp. Oct. 14	8,000
No. 25. Cottonwood (*Populus deltoides*). 3 pp. Oct. 15	8,000
No. 26. Fox-tail Pine (*Pinus balfouriana*). 2 pp. Sept. 28	8,000
No. 27. Torrey Pine (*Pinus Torreyana*). 2 pp. Oct. 15	8,000
No. 28. Black Spruce (*Picea mariana*). 3 pp. Oct. 1	8,000
No. 29. Blue Spruce (*Picea Parryana*). 2 pp. Oct. 28	8,000
No. 30. California Swamp Pine (*Pinus Muricata*). 2 pp. Oct. 28	8,000
No. 31. Black Hemlock (*Tsuga mertensiana*). 4 pp. Oct. 30	8,000
No. 32. Tamarack (*Larix laricina*). 3 pp. Oct. 29	8,000
No. 33. Digger Pine (*Pinus Sabiniana*). 2 pp. Oct. 28	8,000
No. 34. Coulter Pine (*Pinus coulteri*). 2 pp. Oct. 28	8,000
No. 35. Alpine Larch (*Larix lyalli*). 2 pp. Nov. 3	8,000
No. 36. Knobcone Pine (*Pinus attenuata*). 2 pp. Oct. 28	8,000
No. 37. White-bark Pine (*Pinus albicaulis*). 3 pp. Oct. 31	8,000
No. 38. Paper Birch (*Betula papyrifera*). 7 pp. Oct. 29	8,000
No. 39. Monterey Pine (*Pinus radiata*). 2 pp. Oct. 28	8,000
No. 40. Swamp Cottonwood (*Populus heterophylla*). 2 pp. Oct. 28	8,000
No. 41. Chestnut Oak (*Quercus prinus*). 3 pp. Oct. 30	8,000
No. 42. Sugar Maple (*Acer saccharum*). 4 pp. Nov. 4	8,000
No. 48. Pignut Hickory (*Hicoria glabra*). 4 pp. June 22	8,000
No. 49. Shagbark Hickory (*Hicoria ovata*). 4 pp. June 16	8,000
Field Programs:	
For July, 1908. 23 pp. July 2	3,000
For August, 1908. 23 pp. Aug. 3	3,200
Index—July, 1907, to June, 1908. 10 pp. Aug. 21	2,700
For September, 1908. 23 pp. Aug. 31	3,000
For October, 1908. 24 pp. Oct. 1	3,000
For November, 1908. 21 pp. Oct. 31	3,100
For December, 1908. 19 pp. Dec. 2	3,500
For January, 1909. 23 pp. Jan. 2	3,500
For February, 1909. 27 pp. Jan. 30	3,500
For March, 1909. 23 pp. Mar. 1	3,000
For April, 1909. 27 pp. Mar. 31	3,000
For May, 1909. 31 pp. May 1	3,000
For June, 1909. 24 pp. June 1	3,000
Classified Lists of Publications Available for Distribution:	
List for July 15, 1908. 4 pp. July 16	5,000
List for August 15, 1908. 4 pp. Aug. 22	10,000
List for October 15, 1908. 4 pp. Oct. 12	6,000
List for January 15, 1909. 4 pp. Jan. 21	10,000
List for April 1, 1909. 4 pp. Mar. 27	10,000

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
National Forest Areas:	
Location and Area of the National Forests in the United States, Alaska, and Porto Rico, and Dates when Latest Proclamations Became Effective, July 1, 1908. 4 pp. July 21	300
Same, for September 30, 1908. 4 pp. Oct. 13	2,500
Same, for December 31, 1908. 4 pp. Jan. 7	4,000
Same, for March 1, 1909. 4 pp. Mar. 10	3,000
Same, for April 1, 1909. 4 pp. Apr. 8	3,000
Miscellaneous pamphlets and circulars:	
The Use Book: Regulations and Instructions for the Use of the National Forests—1908 (3d revision). Administration Edition. 341 pp. July 1, 5,000; Mar. 11, 500	5,500
Same, Abridged Popular Edition. 109 pp. July 20, 20,000; Sept. 12, 3,000; Nov. 6, 500; Jan. 16, 5,000	28,500
Extent and Importance of the Chestnut Bark Disease. E. R. Hodson. 8 pp. Oct. 21, 13,000; Dec. 15, 1,000	14,000
Manual of Procedure for the Forest Service in Washington and in District Offices. 93 pp. Nov. 14	3,000
Instructions for Building and Maintenance of Telephone Lines on the National Forests. 23 pp. June 7	3,000
Directions for Taking Forest Photographs. 4 pp. July 16	5,000
Instructions for Recording Observations on Leafing, Flowering, and Fruiting of Forest Trees. 3 pp. Apr. 26	5,000
Information Regarding Employment on the National Forests (2d revision). 4 pp. May 6	2,000
Suggestions for the Collection of Range Plant Specimens on National Forests. 3 pp. Apr. 5	3,000
Instructions Regarding Grazing Trespass. 6 pp. May 24	3,000
Farmers' Bulletins:	
No. 340. Declaration of Governors for Conservation of Natural Resources. 7 pp. Dec. 5	20,000
No. 341. The Basket Willow. William F. Hubbard and C. D. Mell. 47 pp. Feb. 17, 10,000; May 15, 10,000	20,000
No. 358. Primer of Forestry. Part II. Practical Forestry. Gifford Pinchot. 48 pp. May 12, 10,000; June 21, 15,000	25,000

EARLIER PUBLICATIONS REPRINTED.

Bulletins:	
No. 28. A Short Account of the Big Trees of California. 30 pp. 15 cts. Nov. 14	250
No. 36. The Woodsman's Handbook. Part I. 148 pp. July 18, 300; Oct. 21, 1,500	1,800
No. 55. Forest Conditions of Northern New Hampshire. A. K. Chittenden. 100 pp. 25 cts. Nov. 3	500
No. 57. Federal and State Forest Laws. George W. Woodruff. 259 pp. 15 cts. Oct. 17	1,000
Circulars:	
No. 12. Southern Pine: Mechanical and Physical Properties. 19 pp. Oct. 16, 800; Feb. 6, 500	1,300
No. 15. Summary of Mechanical Tests on Thirty-two Species of American Woods. 15 pp. Sept. 15, 800; Dec. 18, 1,000	1,800
No. 21, 5th revision. Practical Assistance to Farmers, Lumbermen, and Other Owners of Forest Lands. 5 pp. Sept. 15	2,500
No. 25. Forestry and the Lumber Supply. (1) Forestry and Foresters. Theodore Roosevelt. (2) The Exhaustion of the Lumber Supply. R. L. McCormick. (3) The Lumberman and the Forester. Gifford Pinchot. 14 pp. Nov. 18, 1,000; Apr. 9, 800	1,800
No. 35. Forest Preservation and National Prosperity. (Addresses by President Roosevelt, Ambassador Jusserand, Secretary Wilson, and others.) 31 pp. July 11, 3,000; Dec. 28, 2,000	5,000
No. 36 (4th edition). The Forest Service: What it is and How it Deals with Forest Problems. 39 pp. Sept. 10, 500; Oct. 13, 1,000	1,500
No. 37. Forest Planting in Sand-hill Region of Nebraska. 5 pp. Sept. 12, 500; May 7, 3,000	3,500

Publications issued during the year ended June 30, 1909—Continued.

Circulars—Continued.	Copies.
No. 39, revised. Experiments on the Strength of Treated Timber. W. Kendrick Hatt. 31 pp. July 6	2,000
No. 46. Holding Force of Railroad Spikes in Wooden Ties. W. Kendrick Hatt. 7 pp. Sept. 12	500
No. 49. Timbers Used in the Mines of the United States in 1905. R. S. Kellogg. 8 pp. Sept. 10, 500; Feb. 6, 500	1,000
No. 55. Forest Planting Leaflet. How to Pack and Ship Young Forest Trees. 2 pp. Sept. 12	2,500
No. 59, revised. Forest Planting Leaflet. Eucalypts. 13 pp. Oct. 29, 2,000; May 8, 3,000	5,000
No. 61, revised. Forest Planting Leaflet. How to Transplant Trees. 4 pp. Jan. 11, 1,000; June 5, 2,000	3,000
No. 73. Forest Planting Leaflet. Red Cedar (*Juniperus virginiana*). 4 pp. Sept. 15	1,000
No. 75. Forest Planting Leaflet. Hackberry (*Celtis occidentalis*). 3 pp. Sept. 11	2,000
No. 78. Woods Used for Packing Boxes in New England. J. P. Wentling. 4 pp. Feb. 10	500
No. 80. The Fractional Distillation of Coal-tar Creosote. Arthur L. Dean and Ernest Bateman. 31 pp. Sept. 12, 300; Feb. 19, 300	600
No. 83. Forest Planting Leaflet. Russian Mulberry (*Morus alba tatarica*). 3 pp. Sept. 11	2,000
No. 87. Forest Planting Leaflet. White Willow. 4 pp. June 29	1,000
No. 89. Forest Planting Leaflet. Tamarack (*Larix laricina*). 4 pp. Sept. 11	2,000
No. 91, revised. Forest Planting Leaflet. Coffeetree (*Gymnocladus dioicus*). 4 pp. Mar. 30	700
No. 92. Forest Planting Leaflet. Green Ash (*Fraxinus lanceolata*). 4 pp. Sept. 11	2,000
No. 93. Forest Planting Leaflet. Yellow Poplar. 4 pp. Mar. 30	1,000
No. 94. Forest Planting Leaflet. Black Cherry. 3 pp. May 29	1,000
No. 101. The Open-Tank Method for the Treatment of Timber. Carl G. Crawford. 15 pp. Dec. 17, 500; Apr. 7, 500	1,000
No. 103. Seasoning of Telephone and Telegraph Poles. Henry Grinnell. 16 pp. Sept. 15, 500; Dec. 18, 500	1,000
No. 104. Brush and Tank Pole Treatments. Carl G. Crawford. 24 pp. Sept. 16, 500; Feb. 8, 500	1,000
No. 106. Forest Planting Leaflet. White Oak. 4 pp. May 28	1,000
No. 111. Prolonging the Life of Mine Timbers. John M. Nelson, jr. 22 pp. Feb. 8	500
No. 112. The Analysis and Grading of Creosotes. Arthur L. Dean and Ernest Bateman. 44 pp. Sept. 15, 300; Feb. 19, 300	600
No. 113. Use of Dead Timber in the National Forests. E. R. Hodson. 4 pp. Feb. 20	500
No. 114. Wood Distillation. W. C. Greer. 8 pp. Sept. 16, 500; Feb. 6, 500	1,000
No. 117. The Preservative Treatment of Fence Posts. Howard F. Weiss. 15 pp. Sept. 28, 1,500; Jan. 16, 2,000	3,500
No. 128. Preservation of Piling Against Marine Wood Borers. C. Stowell Smith. 15 pp. July 3, 1,000; July 6, 2,000	3,000
No. 131. Practical Forestry on a Spruce Tract in Maine. Austin Carey. 15 pp. Sept. 15	500
No. 132. The Seasoning and Preservative Treatment of Hemlock and Tamarack Crossties. W. F. Sherfesee. 31 pp. Sept. 15	500
No. 134. The Estimation of Moisture in Creosoted Wood. Arthur L. Dean. 8 pp. July 1, 500; Feb. 6, 500	1,000
No. 136. The Seasoning and Preservative Treatment of Arbor Vitae Poles. C. Stowell Smith. 29 pp. July 7, 1,000; July 23, 1,000	2,000
No. 139. A Primer of Wood Preservation. W. F. Sherfesee. 15 pp. Aug. 11, 30,000; Nov. 3, 500; Dec. 21, 800; Apr. 20, 500	31,800
No. 141. Wood Paving in the United States. C. L. Hill. 24 pp. July 6, 500; Sept. 12, 500; Nov. 10, 500; Feb. 10, 500	2,000
No. 142. Tests of Vehicle and Implement Woods. H. B. Holroyd and H. S. Betts. 29 pp. Sept. 10	800

Publications issued during the year ended June 30, 1909—Continued.

Circulars—Continued.	Copies.
No. 144. Relation of the Southern Appalachian Mountains to the Development of Water Power. M. O. Leighton, M. R. Hall, and R. H. Bolster. 54 pp. Sept. 16	1,000
No. 146. Experiments with Railway Cross-ties. H. B. Eastman. 22 pp. Oct. 10	500
No. 148. Practical Results in Basket Willow Culture. C. D. Mell. 7 pp. Dec. 17, 500; Jan. 16, 1,000	1,500
No. 149. Condition of Cut-over Longleaf Pine Lands in Mississippi. J. S. Holmes and J. H. Foster. 8 pp. July 23	5,000
Annual Report:	
Report of the Forester for 1907. Gifford Pinchot. (From An. Rpts. of Dept., 1907.) 40 pp. July 27, 500; Sept. 14, 500	1,000
Miscellaneous pamphlets, circulars, etc.:	
The Use of the National Forests, 1907. 42 pp. Aug. 11	2,000
Forest Service Atlas: Statistics. 1907. 30 pp. (Quarto.) Mar. 11	400
National Forest Order 23, Part 4. (Instructions for surveying and marking lands for ranger stations.) 20 pp. Aug. 12	1,500
Information Regarding Employment on the National Forests, revised. 4 pp. Jan. 8	2,000
Grazing Trespass by Drifting Stock. 6 pp. Feb. 6	500
Yearbook Extracts:	
No. 329. The Relation of Forests to Stream Flow. James W. Toumey. (From Ybk. 1903.) 14 pp. June 30	1,500
No. 376. How to Grow Young Trees for Planting. E. A. Sterling. (From Ybk. 1905.) 12 pp. July 6, 400; Oct. 30, 4,000	4,400
No. 395. Prolonging the Life of Telephone Poles. Henry Grinnell. (From Ybk. 1905.) 12 pp. Feb. 8	500
No. 434. National Forests and the Lumber Supply. Thos. H. Sherrard. (From Ybk. 1906.) 8 pp. Feb. 10	500
Farmers' Bulletins:	
No. 134. Tree Planting on Rural School Grounds. W. L. Hall. 32 pp. Nov. 19, 15,000; Apr. 10, 10,000; June 10, 10,000	35,000
No. 173. A Primer of Forestry. Part I. The Forest. Gifford Pinchot. 47 pp. Oct. 20, 30,000; Dec. 15, 15,000; Mar. 10, 10,000; Apr. 6, 15,000; June 19, 15,000	85,000
No. 252. Maple Sugar and Sirup. William F. Hubbard. 38 pp. Aug. 7, 10,000; May 18, 5,000	15,000
No. 327. The Conservation of Natural Resources. Gifford Pinchot. 14 pp. Oct. 2, 15,000; Feb. 13, 10,000; Apr. 27, 5,000	30,000

LIBRARY.

New Publications.

Bulletins:	
No. 67. Accessions to the Department Library, January–March, 1908. 72 pp. 10 cts. Sept. 15	1,000
No. 68. Accessions to the Department Library, April–June, 1908. 52 pp. 10 cts. Sept. 15	1,000
No. 69. Accessions to the Department Library, July–September, 1908. 51 pp. 10 cts. Nov. 30	1,000
No. 70. Accessions to the Department Library, October–December, 1908. 61 pp. 10 cts. Mar. 6	1,000
Annual Report:	
Report of the Librarian for 1908. Claribel R. Barnett. (From An. Rpts. of Dept., 1908.) 8 pp. Nov. 2	300

BUREAU OF PLANT INDUSTRY.

New Pubications.

Bulletins:	
No. 129. Barium, a Cause of the Loco-Weed Disease. Albert C. Crawford. 87 pp. 10 cts. Aug. 22	2,500
No. 130. Dry-Land Agriculture: Papers Read at the Second Annual Meeting of the Cooperative Experiment Association of the Great Plains Area, 1907. 90 pp. 10 cts. Oct. 13	3,000

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Bulletins—Continued.	
No. 131, Part V. The Nectaries of Cotton. Frederick J. Tyler. 14 pp. 5 cts. July 7	1,700
No. 131. Miscellaneous Papers. Parts I–V. 56 pp. 10 cts. Aug. 17	2,500
No. 132. Seeds and Plants Imported, July, 1906, to December 31, 1907. Inventory No. 13: Nos. 19058 to 21730. 192 pp. 20 cts. Dec. 5	1,000
No. 133. Peach, Apricot, and Prune Kernels As By-Products of the Fruit Industry of the United States. Frank Rabak. 23 pp. 5 cts. Oct. 26	2,500
No. 134. The Influence of a Mixture of Soluble Salts, Principally Sodium Chlorid, on the Leaf Structure and Transpiration of Wheat, Oats, and Barley. L. L. Harter. 22 pp. 5 cts. Aug. 21	2,000
No. 135. Orchard Fruits in the Piedmont and Blue Ridge Regions of Virginia and the South Atlantic States. H. P. Gould. 102 pp. 20 cts. Jan. 2	5,000
No. 136. Methods and Causes of Evolution. O. F. Cook. 35 pp. 10 cts. Oct. 31	2,000
No. 137. Seeds and Plants Imported, January 1 to March 31, 1908. Inventory No. 14: Nos. 21732 to 22510. 64 pp. 10 cts. Jan. 9	2,000
No. 138. The Production of Cigar-Wrapper Tobacco under Shade in the Connecticut Valley. J. B. Stewart. 31 pp. 15 cts. Dec. 24	5,000
No. 139. American Medicinal Barks. Alice Henkel. 59 pp. 15 cts. June 5	3,600
No. 140. The Spineless Prickly Pears. David Griffiths. 24 pp. 10 cts. Jan. 30	7,000
No. 141, Part I. The Relation of Nicotine to the Quality of Tobacco. Wightman W. Garner. 16 pp. 5 cts. Sept. 18	2,000
No. 141, Part II. The Granville Tobacco Wilt. Erwin F. Smith. 11 pp. 5 cts. Sept. 3	3,000
No. 141, Part III. The Florida Velvet Bean and Its History. Katherine S. Bort. 32 pp. 10 cts. May 19	2,000
No. 141, Part IV. The Importance of Broad Breeding in Corn. G. N. Collins. 16 pp. 5 cts. June 4	2,000
No. 142. Seeds and Plants Imported, April to June 30, 1908. Inventory No. 15: Nos. 22511 to 23322. 81 pp. 10 cts. Feb. 26	2,000
No. 143. Principles and Practical Methods of Curing Tobacco. W. W. Garner. 54 pp. 10 cts. Feb. 16	2,700
No. 144. Apple Blotch: A Serious Disease of Southern Orchards. W. M. Scott and James B. Rorer. 28 pp. 15 cts. Mar. 6	6,000
No. 145. Vegetation Affected by Agriculture in Central America. O. F. Cook. 30 pp. 15 cts. Apr. 10	2,000
No. 146. The Superiority of Line Breeding over Narrow Breeding. O. F. Cook. 45 pp. 10 cts. Apr. 29	2,000
No. 147. Suppressed and Intensified Characters in Cotton Hybrids. O. F. Cook. 27 pp. 15 cts. Apr. 7	2,000
No. 148. Seeds and Plants Imported, July 1 to Sept. 30, 1908. Inventory No. 16: Nos. 23323 to 23744. 37 pp. 10 cts. Apr. 10	2,000
No. 150. The Wild Alfalfas and Clovers of Siberia, With a Perspective View of the Alfalfas of the World. N. E. Hansen. 31 pp. 10 cts. May 27	2,500
No. 151. Fruits Recommended by the American Pomological Society for Cultivation in the Various Sections of the United States and Canada. 69 pp. 15 cts. June 28	4,000
No. 153. Seeds and Plants Imported, Oct. 1 to Dec. 31, 1908. Inventory No. 17: Nos. 23745 to 24429. 58 pp. 10 cts. June 30	2,000
Circulars:	
No. 11. Danger in Judging Cotton Varieties by Lint Percentages. O. F. Cook. 16 pp. Aug. 25	2,000
No. 12. Dry-Land Grains. William M. Jardine. 14 pp. Aug. 21, 3,000; Nov. 6, 1,500; Feb. 26, 1,000	5,500
No. 13. The Work of the San Antonio Experiment Farm in 1907. Frank B. Headley. 16 pp. Sept. 4, 2,000; Nov. 20, 500; Feb. 5, 1,000	3,500

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Circulars—Continued.	
No. 14. Changes of Vegetation on the South Texas Prairies. O. F. Cook. 7 pp. Sept. 19	2,000
No. 15. The Fertilizing Value of Hairy Vetch for Connecticut Tobacco Fields. T. R. Robinson. 5 pp. Oct. 8	5,000
No. 16. A New Basis for Barley Valuation and Improvement. Albert Mann. 8 pp. Nov. 27	2,000
No. 17. Index to Papers Relating to Plant Industry Subjects in the Yearbooks of the U. S. Department of Agriculture. 55 pp. Nov. 30	2,500
No. 18. Reappearance of a Primitive Character in Cotton Hybrids. O. F. Cook. 11 pp. Nov. 30	2,000
No. 19. The Decay of Florida Oranges While in Transit and on Market. Lloyd S. Tenney, G. W. Hosford, and H. M. White. 8 pp. Dec. 16, 3,000; Apr. 12, 2,000	5,000
No. 20. An Electrical-Resistance Method for the Rapid Determination of the Moisture Content of Grain. Lyman J. Briggs. 8 pp. Dec. 11	2,000
No. 21. Farmers' Cooperative Demonstration Work in Its Relation to Rural Improvement. S. A. Knapp. 20 pp. Dec. 15	42,000
No. 22. Farm Methods of Applying Land Plaster in Western Oregon and Washington. Byron Hunter. 14 pp. Feb. 24	5,200
No. 23. Potato Diseases in San Joaquin County, California. W. A. Orton. 14 pp. Jan. 25	2,500
No. 24. Alfalfa in Cultivated Rows for Seed Production in Semiarid Regions. Charles J. Brand and J. M. Westgate. 23 pp. Mar. 5	5,000
No. 25. The Cost of Clearing Logged-off Land for Farming in the Pacific Northwest. Harry Thompson. 16 pp. Apr. 10	5,000
No. 26. Some Factors Affecting the Keeping Qualities of American Lemons. Rodney H. True and Arthur F. Sievers. 17 pp. May 26, 2,500; June 14, 2,500	5,000
No. 27. Lime-Sulphur Mixtures for Summer Spraying of Orchards. W. M. Scott. 17 pp. Apr. 22, 6,000; June 1, 2,000	8,000
No. 28. Clover-Seed Production in the Willamette Valley, Oregon. Byron Hunter. 15 pp. Apr. 28	4,000
No. 29. Experiments with Egyptian Cotton in 1908. Thomas H. Kearney and William A. Peterson. 22 pp. Apr. 17	2,500
No. 31. Notes on the Number and Distribution of Native Legumes in Nebraska and Kansas. Joseph A. Warren. 9 pp. June 9	3,000
No. 33. The Necessity for New Standards of Hop Valuation. W. W. Stockberger. 11 pp. June 15	3,000
Annual Report:	
Report of Chief of Bureau of Plant Industry, 1908. B. T. Galloway. (From An. Rpts. of Dept., 1908.) 135 pp. Dec. 10	2,500
Yearbook Extracts:	
No. 441. Progress in Some New Work of the Bureau of Plant Industry. B. T. Galloway. (From Ybk. 1907.) 13 pp. Sept. 10	1,000
No. 446. The Art of Seed Selection and Breeding. A. D. Shamel. (From Ybk. 1907.) 19 pp. Aug. 27, 1,000; Dec. 30, 1,000	2,000
No. 450. Promising New Fruits. W. A. Taylor. (From Ybk. 1907.) 19 pp. Sept. 2	5,000
No. 453. The Status of the American Lemon Industry. C. Harold Powell. (From Ybk. 1907.) 20 pp. Sept. 1	5,000
No. 456. Cropping Systems for Stock Farms. W. J. Spillman. 16 pp. Aug. 15	5,000
No. 459. Truck Farming in the Atlantic Coast States. L. C. Corbett. (From Ybk. 1907.) 12 pp. Aug. 25	4,000
No. 461. Dry-Land Farming in the Great Plains Area. E. L. Chilcott. (From Ybk. 1907.) Aug. 17	3,000
No. 463. Diseases of Ornamental Trees. Haven Metcalf. (From Ybk. 1907.) 15 pp. Aug. 25	5,000
No. 467. Plant Diseases in 1907. W. A. Orton and Adeline Ames. (From Ybk. 1907.) 15 pp. Aug. 18	500

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Miscellaneous Circulars:	
The Colman Citrange. 3 pp. Aug. 19, 1,000; Jan. 30, 500	1,500
The Morton Citrange. 4 pp. Aug. 25, 500; Nov. 23, 500; Jan. 30, 500	1,500
The Rustic Citrange. 3 pp. Aug. 29	500
The Savage Citrange. 3 pp. Aug. 19, 1,000; Feb. 15, 500	1,500
Familiar Talks on Farming.—Diversification. (No. "A"—62.) S. A. Knapp. 4 pp. July 10	50,000
Seed Selection for Southern Farms. (No. "A"—63.) S. A. Knapp. 8 pp. Aug. 1	75,000
Factors Affecting the Keeping Quality of Table Grapes While in Transit and in Storage. A. V. Stubenrauch. 3 pp. Aug. 6	1,000
Deep Fall Plowing and the Seed Bed. (No. "A"—64.) S. A. Knapp. 7 pp. Oct. 2	75,000
The Wild Onion. J. S. Cates and S. R. Cox. 6 pp. Dec. 1	10,000
Brief Directions for the Cultivation of Tobacco in 1909. A. D. Shamel and E. H. Mathewson. 24 pp. Jan. 9	2,000
Distribution of Cotton Seed in 1909. D. N. Shoemaker. 16 pp. Jan. 16	10,000
Directions for Making Window Gardens. W. W. Tracy, sr. 8 pp. 3d Ed., rev., Feb. 4, 4,000; Mar. 26, 10,000. 4th Ed., May 14, 12,000	26,000
Cooperative Distribution of New Varieties of Smyrna Figs and Caprifigs. Walter T. Swingle. 6 pp. Jan. 27	3,000
Field Instructions for Farmers' Cooperative Demonstration Work.—Commercial Fertilizers. (No. "A"—65.) S. A. Knapp. 4 pp. Feb. 17, 5,000; Mar. 5, 55,000; Mar. 25, 25,000	85,000
Directions for Preparing Herbarium Specimens of Grasses. A. S. Hitchcock and Agnes Chase. 4 pp. Mar. 2	1,100
Hints to Settlers on the Truckee-Carson Project, Nevada. Thos. H. Means and Shober J. Rogers. 8 pp. Mar. 10	1,300
Hints to Settlers on the Minidoka Project, Idaho. Alex. McPherson. 4 pp. Mar. 22	4,500
Hints to Settlers on the Belle Fourche Project, South Dakota. C. A. Jensen. 7 pp. Mar. 19, 1,300; Apr. 1, 700	2,000
Hints to Settlers on the North Platte Project, Nebraska. J. A. Warren. 4 pp. Mar. 25	1,900
Hints to Settlers on the Williston Project, North Dakota. J. C. McDowell. 4 pp. Mar. 29	1,800
Hints to Settlers on the Sun River Project, Montana. J. S. Cotton and W. A. Remington. 7 pp. Apr. 7	2,000
Agricultural Conditions in Southern Texas. 8 pp. Mar. 24	10,000
American Ginseng. Rodney H. True. 3 pp. June 5	1,000
Farm Notes. (No. "A"—66.) S. A. Knapp. 3 pp. June 18	60,000
The Selection of Cotton and Corn Seed for Southern Farms. (No. "A"—67.) S. A. Knapp. 8 pp. June 22	50,000
List of Bulletins of the Bureau of Plant Industry. 4 pp. July 2, 500; Aug. 3, 1,000; Jan. 2, 1,000	2,500
Publications of the Bureau of Plant Industry. 10 pp. Feb. 13, 3,000; June 12, 2,000	5,000
Farmers' Bulletins:	
No. 331. Forage Crops for Hogs in Kansas and Oklahoma. C. R. Quinn. 24 pp. Aug. 5, 15,000; Nov. 4, 20,000	35,000
No. 333. Cotton Wilt. W. A. Orton. 24 pp. Sept. 30, 15,000; Mar. 31, 10,000	25,000
No. 337. Cropping Systems for New England Dairy Farms. L. G. Dodge. 24 pp. Oct. 27, 20,000; May 18, 10,000	30,000
No. 339. Alfalfa. J. M. Westgate. 48 pp. Dec. 12, 30,000; Feb. 3, 15,000; Mar. 17, 20,000; Apr. 6, 40,000	105,000
No. 343. The Cultivation of Tobacco in Kentucky and Tennessee. W. H. Scherffius, H. Woosley, and C. A. Mahan. 31 pp. Jan. 21, 30,000; May 25, 15,000	45,000
No. 347. The Repair of Farm Equipment. W. R. Beattie. 32 pp. Feb. 15, 30,000; June 11, 15,000	45,000

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Farmers' Bulletins—Continued.	
No. 354. Onion Culture. W. R. Beattie. 36 pp. Apr. 26, 30,000; June 22, 15,000	45,000
No. 355. A Successful Dairy and Poultry Farm. W. J. Spillman. 40 pp. Apr. 27, 20,000; June 15, 15,000; June 27, 10,000	45,000
No. 356. Peanuts. W. R. Beattie. 40 pp. May 1	20,000
No. 361. Meadow Fescue: Its Culture and Uses. H. N. Vinall. 24 pp. June 15	10,000
EARLIER PUBLICATIONS REPRINTED.	
Bulletins:	
No. 42. Three New Plant Introductions from Japan. David G. Fairchild. 24 pp. 10 cts. July 6	300
No. 53. The Date Palm and Its Utilization in the Southwestern States. Walter T. Swingle. 155 pp. 20 cts. Oct. 16	300
No. 102, Part I. Summary of Recent Investigations of the Value of Cacti as Food. David Griffiths and R. F. Hare. 16 pp. 5 cts. July 28	300
No. 111, Part IV. Forage Crops for Hogs in Kansas and Oklahoma. C. E. Quinn. 24 pp. 5 cts. July 8	500
No. 118. Peruvian Alfalfa: A New Long-Season Variety for the Southwest. Charles J. Brand. 35 pp. 10 cts. July 11	500
No. 116. The Tuna as Food for Man. David Griffiths and R. F. Hare. 73 pp. 25 cts. July 27	300
No. 29 (Division of Vegetable Physiology and Pathology). Plant Breeding. Willet M. Hays. 72 pp. 10 cts. July 10	1,500
Circulars:	
No. 1. Self-Boiled Lime-Sulphur Mixture as a Promising Fungicide. W. M. Scott. 18 pp. Aug. 23, 500; Oct. 16, 1,000	1,500
No. 4. The Treatment of Damping-Off in Coniferous Seedlings. Perley Spaulding. 8 pp. Feb. 11	1,000
No. 6. The Cultivation and Handling of Golden Seal. Alice Henkel and G. Fred Klugh. 19 pp. Oct. 23, 2,500; June 11, 2,000	4,500
No. 9. Texas Root-Rot of Cotton: Field Experiments in 1907. C. L. Shear and George F. Miles. 7 pp. Feb. 5	1,000
No. 10. Notes on Dry Farming. William M. Jardine. 6 pp. Oct. 22, 1,000; Dec. 23, 1,000	2,000
Yearbook Extracts:	
No. 124. Hybrids and Their Utilization in Plant Breeding. Walter T. Swingle and Herbert J. Webber. (From Ybk. 1897.) 41 pp. Jan. 9	2,000
No. 215. Commercial Pear Culture. M. B. Waite. 31 pp. Aug. 5	1,500
No. 225. The Relation of Nutrition to the Health of Plants. Albert F. Woods. (From Ybk. 1901.) 24 pp. Oct. 26	500
No. 281. Grape, Raisin, and Wine Production in the United States. George C. Husmann. (From Ybk. 1902.) 16 pp. Dec. 18	2,000
No. 284. Plants as a Factor in Home Adornment. L. C. Corbett. (From Ybk. 1902.) 20 pp. Dec. 8	2,000
No. 287. Improvement of Corn by Seed Selection. C. P. Hartley. (From Ybk. 1902.) 16 pp. Oct. 3	3,000
No. 290. Fertilizers for Special Crops. A. F. Woods and R. E. B. McKenney. (From Ybk. 1902.) 24 pp. July 17, 500; Nov. 17, 3,000	3,500
No. 354. Some Uses of the Grapevine and Its Fruit. George C. Husmann. (From Ybk. 1904.) 20 pp. Sept. 3, 1,000; June 21, 2,000	3,000
No. 377. Diversified Farming in the Cotton Belt. I. The Atlantic Coast States; W. J. Spillman. II. Alabama and Mississippi; M. A. Crosby. III. Louisiana, Arkansas, and Northeastern Texas; D. A. Brodie. IV. Texas; C. W. Warburton. (From Ybk. 1905.) 39 pp. Aug. 21	1,000
No. 399. Promising New Fruits. W. A. Taylor. (From Ybk. 1905.) 16 pp. Dec. 14	2,000
No. 411. The Present Status of the Nitrogen Problem. A. F. Woods. (From Ybk. 1906.) 16 pp. Mar. 30	500

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Miscellaneous Circulars:	
Field Instructions for Farmers' Cooperative Demonstration Work. (No. "A"—51, rev.) S. A. Knapp. 7 pp. Nov. 10, 75,000; Mar. 26, 40,000	115,000
Economize! Cut Down the Expenses of the Farm. (No. "A"—52.) S. A. Knapp. 5 pp. Nov. 25	40,000
The Citrange: A New Citrus Fruit. 2 pp. Aug. 11	3,000
The Chayote: A New Winter Vegetable from the South. David Fairchild. 2 pp. Sept. 26	500
Model Plan for a Southern Farm. 11 pp. Sept. 15	1,000
Farmers' Bulletins:	
No. 28, 2d revision. Weeds, and How to Kill Them. Lyster H. Dewey. 32 pp. Aug. 29, 10,000; Nov. 4, 10,000; Mar. 3, 10,000; May 26, 10,000	40,000
No. 33. Peach Growing for Market. Erwin F. Smith. 23 pp. Oct. 16, 10,000; Apr. 8, 15,000	25,000
No. 58, revised. The Soy Bean as a Forage Crop. Thomas A. Williams. With an appendix on Soy Beans as Food for Man. C. F. Langworthy. 23 pp. Mar. 23	10,000
No. 66, 2d revision. Meadows and Pastures: Formation and Cultivation in the Middle Eastern States. Jared G. Smith. 31 pp. Oct. 9, 5,000; Nov. 28, 10,000; Apr. 17, 5,000	20,000
No. 86. Thirty Poisonous Plants of the United States. V. K. Chesnut. 32 pp. July 23, 10,000; Nov. 19, 10,000; Mar. 31, 10,000	30,000
No. 91. Potato Diseases and Their Treatment. B. T. Galloway. 15 pp. Aug. 18, 10,000; Oct. 29, 10,000; Mar. 5, 10,000; May 29, 10,000	40,000
No. 101. Millets. Thomas A. Williams. 32 pp. Sept. 17, 5,000; Nov. 13, 10,000	15,000
No. 102. Southern Forage Plants. F. Lamson-Scribner. 48 pp. July 27	10,000
No. 110. Rice Culture in the United States. S. A. Knapp. 30 pp. Oct. 14	10,000
No. 113, revised. The Apple and How to Grow It. G. B. Brackett. 32 pp. July 27, 10,000; Sept. 23, 10,000; Mar. 18, 15,000; May 28, 20,000	55,000
No. 118. Grape Growing in the South. S. M. Tracy. 32 pp. Nov. 19, 5,000; Mar. 24, 10,000	15,000
No. 139. Emmer: A Grain for the Semiarid Regions. Mark Alfred Carleton. 15 pp. Sept. 24, 5,000; June 10, 5,000	10,000
No. 140. Pineapple Growing. Peter H. Rolfs. 47 pp. Apr. 6	5,000
No. 147. Winter Forage Crops for the South. 39 pp. Aug. 28, 10,000; Mar. 29, 5,000	15,000
No. 154. The Home Fruit Garden: Preparation and Care. L. C. Corbett. (Edition of June, 1905.) 16 pp. Sept. 4, 10,000; Nov. 2, 15,000; Mar. 16, 15,000; May 27, 15,000	55,000
No. 156. The Home Vineyard, with Special Reference to Northern Conditions. W. H. Ragan. 24 pp. July 29, 10,000; Nov. 4, 10,000; Apr. 12, 15,000	35,000
No. 157. The Propagation of Plants. L. C. Corbett. 23 pp. Sept. 4, 10,000; Feb. 5, 10,000; June 2, 10,000	30,000
No. 164. Rape as a Forage Crop. A. S. Hitchcock. 16 pp. Aug. 14, 10,000; May 27, 5,000	15,000
No. 174. Broom Corn. C. P. Hartley. 32 pp. Sept. 15, 5,000; Apr. 10, 5,000	10,000
No. 175. Home Manufacture and Use of Unfermented Grape Juice. George C. Husmann. 15 pp. Oct. 9, 5,000; May 29, 5,000	10,000
No. 176. Cranberry Culture. L. C. Corbett. 20 pp. Oct. 14, 5,000; Apr. 26, 5,000	10,000
No. 181. Pruning. L. C. Corbett. 39 pp. July 24, 10,000; Nov. 4, 10,000; Feb. 10, 10,000; May 3, 10,000	40,000
No. 185. Beautifying the Home Grounds. L. C. Corbett. 24 pp. Sept. 9, 15,000; Feb. 8, 10,000; Apr. 29, 10,000	35,000

Publications issued during the year ended June 30, 1909—Continued.

Farmers' Bulletins—Continued.	Copies.
No. 188. Weeds Used in Medicine. Alice Henkel. 45 pp. Sept. 24, 10,000; Apr. 12, 10,000	20,000
No. 194. Alfalfa Seed. Edgar Brown. 15 pp. Dec. 12, 10,000; May 27, 10,000	20,000
No. 195. Annual Flowering Plants. L. C. Corbett. 48 pp. May 26	15,000
No. 198. Strawberries. L. C. Corbett. 24 pp. Sept. 4, 10,000; Sept. 12, 15,000; Apr. 13, 15,000; June 22, 10,000	50,000
No. 199. Corn Growing. C. P. Hartley. 31 pp. Sept. 17, 15,000; Oct. 3, 20,000; Feb. 1, 15,000; Feb. 11, 15,000; June 3, 15,000	80,000
No. 204. The Cultivation of Mushrooms. B. M. Duggar. 24 pp. Nov. 5, 10,000; Apr. 6, 5,000; May 18, 10,000	25,000
No. 208. Varieties of Fruits Recommended for Planting. 48 pp. Aug. 28	10,000
No. 213. Raspberries. L. C. Corbett. 39 pp. Mar. 27, 10,000; June 15, 10,000	20,000
No. 215. Alfalfa Growing. A. S. Hitchcock. 39 pp. Sept. 4, 10,000; Nov. 2, 10,000	20,000
No. 217. Essential Steps in Securing an Early Crop of Cotton. R. J. Redding. 16 pp. Sept. 25, 10,000; Apr. 27, 10,000	20,000
No. 218. The School Garden. L. C. Corbett. 43 pp. Oct. 5, 10,000; Oct. 6, 15,000; May 25, 15,000	40,000
No. 219. Lessons from the Grain-Rust Epidemic of 1904. Mark Alfred Carleton. 24 pp. Oct. 21	10,000
No. 220. Tomatoes. L. C. Corbett. 32 pp. Nov. 5, 10,000; Feb. 2, 10,000; Apr. 22, 15,000	35,000
No. 224. Canadian Field Peas. Thomas Shaw. 16 pp. Nov. 4	10,000
No. 229. The Production of Good Seed Corn. C. P. Hartley. With an appendix on Selection and Care of Seed Corn. Herbert J. Webber. 23 pp. Oct. 6, 10,000; Jan. 7, 10,000; Feb. 6, 10,000; Apr. 6, 15,000; June 10, 15,000	60,000
No. 231. Spraying for Cucumber and Melon Diseases. W. A. Orton. 24 pp. Dec. 2, 10,000; May 6, 10,000	20,000
No. 232. Okra: Its Culture and Uses. W. R. Beattie. 16 pp. Sept. 25, 10,000; June 10, 10,000	20,000
No. 238. Citrus Fruit Growing in the Gulf States. P. H. Rolfs. 48 pp. Nov. 30	10,000
No. 242. An Example of Model Farming. W. J. Spillman. 16 pp. Aug. 7, 10,000; Nov. 9, 10,000; Mar. 25, 10,000; May 28, 15,000	45,000
No. 243. Fungicides and Their Use in Preventing Diseases of Fruits. M. B. Waite. 32 pp. Nov. 16, 5,000; Apr. 6, 10,000	15,000
No. 245. Renovation of Worn-out Soils. W. J. Spillman. 16 pp. Oct. 19, 10,000; Mar. 15, 15,000	25,000
No. 246. Saccharine Sorghums for Forage. Carleton R. Ball. 37 pp. Oct. 13, 10,000; May 21, 5,000	15,000
No. 248. The Lawn. L. C. Corbett. 20 pp. Nov. 6, 15,000; May 19, 15,000	30,000
No. 250. The Prevention of Stinking Smut of Wheat and Loose Smut of Oats. Walter T. Swingle. 16 pp. Sept. 1, 10,000; Mar. 6, 5,000	15,000
No. 253. The Germination of Seed Corn. J. W. T. Duvel. 16 pp. Nov. 24, 10,000; Apr. 23, 15,000	25,000
No. 254. Cucumbers. L. C. Corbett. 32 pp. July 24, 10,000; Oct. 30, 10,000; June 10, 10,000	30,000
No. 255. The Home Vegetable Garden. W. R. Beattie. 47 pp. July 11, 10,000; Sept. 9, 20,000; Jan. 4, 10,000; Feb. 6, 15,000; Apr. 20, 15,000; Apr. 30, 10,000; May 18, 15,000; June 8, 15,000; June 25, 20,000	130,000
No. 260. Seed of Red Clover and Its Impurities. Edgar Brown and F. H. Hillman. 24 pp. Nov. 13, 10,000; May 26, 10,000	20,000
No. 271. Forage-Crop Practices in Western Oregon and Western Washington. Byron Hunter. 39 pp. Oct. 16	10,000

Publications issued during the year ended June 30, 1909—Continued.

Farmers' Bulletins—Continued.	Copies.
No. 272. A Successful Hog and Seed-Corn Farm. W. J. Spillman. 16 pp. July 14, 10,000; Oct. 16, 10,000; Feb. 13, 10,000; May 28, 10,000	40,000
No. 274. Flax Culture. (From a report of H. L. Bolley.) 38 pp. June 12	5,000
No. 278. Leguminous Crops for Green Manuring. C. V. Piper. 29 pp. Aug. 3, 10,000; Sept. 15, 15,000; Mar. 30, 10,000; Apr. 24, 10,000	45,000
No. 279. A Method of Eradicating Johnson Grass. J. S. Cates. 16 pp. Sept. 26, 5,000; Feb. 9, 5,000; May 27, 10,000	20,000
No. 280. A Profitable Tenant Dairy Farm. Lyman Carrier. 16 pp. Oct. 1, 10,000; Mar. 6, 5,000; May 29, 10,000	25,000
No. 282. Celery. W. R. Beattie. 36 pp. Sept. 2, 10,000; Feb. 9, 10,000; May 26, 10,000	30,000
No. 283. Spraying for Apple Diseases and the Codling Moth in the Ozarks. W. M. Scott and A. L. Quaintance. 44 pp. May 19	5,000
No. 285. The Advantages of Planting Heavy Cotton Seed. Herbert J. Webber and E. B. Boykin. 16 pp. Sept. 28, 10,000; Apr. 23, 10,000	20,000
No. 286. Comparative Value of Whole Cotton Seed and Cotton-Seed Meal in Fertilizing Cotton. E. B. Boykin. 16 pp. Nov. 9, 10,000; June 28, 10,000	20,000
No. 288. The Nonsaccharine Sorghums. C. W. Warburton. 30 pp. Apr. 29	5,000
No. 289. Beans. L. C. Corbett. 30 pp. Aug. 1, 15,000; Sept. 26, 10,000; May 14, 15,000	40,000
No. 291. Evaporation of Apples. H. P. Gould. 40 pp. July 24, 10,000; Apr. 28, 10,000	20,000
No. 292. Cost of Filling Silos. Lyman Carrier. 15 pp. Sept. 30, 10,000; May 27, 10,000	20,000
No. 294. Farm Practice in the Columbia Basin Uplands. Byron Hunter. 32 pp. May 20	5,000
No. 299. Diversified Farming Under the Plantation System. D. A. Brodie and C. K. McClelland. 16 pp. Sept. 28	10,000
No. 300. Some Important Grasses and Forage Plants for the Gulf Coast States. S. M. Tracy. 15 pp. Oct. 5, 5,000; Mar. 29, 5,000	10,000
No. 301. Home-Grown Tea. George F. Mitchell. 16 pp. Sept. 28	10,000
No. 302. Sea Island Cotton: Its Culture, Improvement, and Diseases. W. A. Orton. 48 pp. July 16, 10,000; May 25, 10,000	20,000
No. 304. Growing and Curing Hops. W. W. Stockberger. 39 pp. May 26	5,000
No. 307. Roselle: Its Culture and Uses. P. J. Wester. 16 pp. Sept. 29	10,000
No. 310. A Successful Alabama Diversification Farm. M. A. Crosby, J. F. Duggar, and W. J. Spillman. 24 pp. Sept. 9, 10,000; Nov. 16, 10,000; May 10, 10,000	30,000
No. 312. A Successful Southern Hay Farm. Harmon Benton. 15 pp. Sept. 3, 10,000; Sept. 28, 10,00; Feb. 2, 10,000; May 8, 10,000	40,000
No. 313. Harvesting and Storing Corn. C. P. Hartley. 31 pp. July 30, 30,000; Sept. 15, 15,000; Feb. 10, 10,000; Apr. 26, 15,000	70,000
No. 314. A Method of Breeding Early Cotton to Escape Boll-Weevil Damage. R. L. Bennett. 30 pp. Sept. 3, 10,000; Oct. 22, 15,000; Mar. 22, 30,000	55,000
No. 315. Progress in Legume Inoculation. Karl F. Kellerman and T. R. Robinson. 20 pp. Sept. 15	15,000
No. 318. Cowpeas. H. T. Nielsen. 30 pp. Aug. 12, 15,000; Sept. 30, 15,000; Mar. 29, 10,000; May 10, 40,000; June 7, 15,000; June 11, 20,000	115,000
No. 319. Demonstration Work in Cooperation with Southern Farmers. S. A. Knapp. 24 pp. Mar. 29, 5,000; May 18, 10,000	15,000
No. 322. Milo as a Dry-Land Grain Crop. Carleton R. Ball and Arthur H. Leidigh. 23 pp. Aug. 6, 10,000; Oct. 14, 15,000; May 10, 10,000	35,000

Publications issued during the year ended June 30, 1909—Continued.

Farmers' Bulletins—Continued.	Copies.
No. 323. Clover Farming on the Sandy Jack-Pine Lands of the North. C. Beaman Smith. 24 pp. Aug. 7, 15,000; Oct. 9, 15,000	30,000
No. 324. Sweet Potatoes. W. R. Beattie. 39 pp. Sept. 5, 30,000; Apr. 22, 10,000; June 11, 15,000	55,000
No. 325. Small Farms in the Corn Belt. J. A. Warren. 31 pp. Aug. 6, 10,000; Sept. 11, 15,000; Apr. 20, 15,000	40,000
No. 326. Building Up a Run-Down Cotton Plantation. C. A. Brodie. 24 pp. Sept. 10, 15,000; Feb. 8, 15,000; June 11, 10,000	40,000

DIVISION OF PUBLICATIONS.

New Publications.

Bulletin:	
No. 9. Index to Yearbooks of the Department, 1901–1905. Chas. H. Greathouse. 166 pp. 20 cts. Feb. 1	1,000
Circulars:	
No. 1, revised to February 15, 1909. Organization of the Department of Agriculture. 45 pp. Mar. 23	2,000
No. 2, revised to June 10, 1908. List of Publications for Free Distribution. 75 pp. July 8	5,000
No. 2, revised to September 1, 1908. 76 pp. Oct. 3, 10,000; Jan. 22, 2,000; Mar. 3, 2,000	14,000
No. 2, revised to March 1, 1909. 45 pp. Apr. 10, 5,000; Apr. 26, 5,000; June 14, 2,000	12,000
No. 3, revised to June 15, 1908. List of Publications for Sale. 99 pp. Aug. 22, 5,000; Oct. 24, 10,000	15,000
No. 3, revised to December 1, 1908. 128 pp. Apr. 14, 5,000; May 8, 5,000	10,000
No. 4, revised. Farmers' Bulletin Subject Index (revised to include F. B. No. 331). 33 pp. Oct. 10	5,000
No. 4, revised to include F. B. No. 351. 34 pp. Mar. 17	10,000
No. 5, revised. Food and Drugs Index. 14 pp. Nov. 14	1,500
Annual Report:	
Report of the Editor for 1908. Geo. Wm. Hill. (From An. Rpts. of Dept., 1908.) 80 pp. Dec. 17	1,200
Yearbook Extract:	
No. 464. A Directory for Farmers. (From Ybk. 1907.) 25 pp. Aug. 11	10,000
Monthly List of Publications:	
May, 1908. Foreign.[a] 3 pp. July 20	5,000
June, 1908. Domestic.[a] 4 pp. July 17	230,000
June, 1908. Foreign. 4 pp. July 30	5,000
July, 1908. Domestic. 4 pp. Aug. 12	235,000
July, 1908. Foreign. 4 pp. Aug. 28	4,000
August, 1908. Domestic. 4 pp. Sept. 16	235,000
August, 1908. Foreign. 4 pp. Sept. 30	4,000
September, 1908. Domestic. 4 pp. Oct. 9	235,000
September, 1908. Foreign. 4 pp. Oct. 19	4,000
October, 1908. Domestic. 4 pp. Nov. 13	235,000
October, 1908. Foreign. 4 pp. Nov. 21	4,000
November, 1908. Domestic. 4 pp. Dec. 9	230,000
November, 1908. Foreign. 3 pp. Dec. 17	4,500
December, 1908. Domestic. 4 pp. Jan. 12	230,000
December, 1908. Foreign. 4 pp. Jan. 27	4,500
January, 1909. Domestic. 4 pp. Feb. 11	230,000
January, 1909. Foreign. 4 pp. Mar. 8	4,500
February, 1909. Domestic. 4 pp. Mar. 13	235,000
February, 1909. Foreign. 4 pp. Mar. 26	4,500
March–April, 1909. Domestic. 4 pp. May 10, 230,000; May 15, 10,000	240,000

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[a] Two lists are issued, one for a wide distribution in the United States, the other for a limited distribution in foreign countries.

Publications issued during the year ended June 30, 1909—Continued.

Monthly List of Publications—Continued.	Copies.
March, 1909. Foreign. 4 pp. Apr. 21	4,500
April, 1909. Foreign. 4 pp. May 27	5,000
May, 1909. Foreign. 4 pp. June 25	5,000
List of Farmers' Bulletins available for distribution (several revisions). 3 pp. July 24, 17,000; Aug. 13, 50,000; Sept. 30, 10,000; Oct. 10, 50,000; Dec. 9, 50,000; Jan. 20, 30,000; Mar. 31, 20,000; Apr. 5, 20,000; Apr. 22, 50,000; May 18, 50,000; May 28, 40,000; June 1, 40,000; June 16, 50,000	477,000

EARLIER PUBLICATIONS REPRINTED.

Farmers' Bulletins:	
No. 61. Asparagus Culture. R. B. Handy. 39 pp. Sept. 4, 10,000; Feb. 5, 5,000; Apr. 27, 5,000; June 4, 10,000	30,000
No. 62. Marketing Farm Produce. George G. Hill. 31 pp. Sept. 23, 10,000; Jan. 29, 5,000; Mar. 25, 10,000; June 1, 10,000	35,000
No. 98. Suggestions to Southern Farmers. 48 pp. Oct. 19, 10,000; Apr. 6, 10,000	20,000
No. 126. Practical Suggestions for Farm Buildings. George G. Hill. 48 pp. Aug. 27, 10,000; Nov. 6, 15,000; Apr. 10, 10,000; June 15, 10,000	45,000
No. 150. Clearing New Land. Franklin Williams, jr. 24 pp. July 14, 10,000; Feb. 4, 5,000; Feb. 6, 10,000	25,000

OFFICE OF PUBLIC ROADS.

NEW PUBLICATIONS.

Bulletins:	
No. 33. Road Materials of Southern and Eastern Maine. Henry Leighton and Edson D. Bastin. 56 pp. 10 cts. Dec. 21	4,000
No. 34. Dust Preventives. Prevost Hubbard. 64 pp. 10 cts. Sept. 23	10,000
No. 35. The Preservation of Iron and Steel. Allerton S. Cushman. 40 pp. 10 cts. May 21	5,000
Circulars:	
No. 88, 2d revision. Publications of the Office of Public Roads. 5 pp. Aug. 28	1,500
No. 90. Progress Reports of Experiments in Dust Prevention, Road Preservation, and Road Construction. 23 pp. May 11	5,000
Yearbook Extract:	
No. 448. Dust Preventives. Logan Waller Page. (From Ybk. 1907.) 13 pp. Sept. 17	5,000
Annual Report:	
Report of Director for 1908. Logan Waller Page. 30 pp. (From An. Rpts. of Dept., 1908.) Dec. 18, 600; June 6, 200	800
Farmers' Bulletin:	
No. 338. Macadam Roads. Austin B. Fletcher. 39 pp. Oct. 24, 20,000; Mar. 15, 20,000; June 30, 10,000	50,000

EARLIER PUBLICATIONS REPRINTED.

Yearbook Extracts:	
No. 204. Selection of Material for Macadam Roads. Logan Waller Page. (From Ybk., 1900.) 11 pp. Dec. 30	1,000
No. 296. Use of Mineral Oil in Road Improvement. James W. Abbott. (From Ybk., 1902.) 19 pp. Oct. 30	1,000
No. 350. Practical Road Building in Madison County, Tennessee. Sam C. Lancaster. (From Ybk., 1904.) 20 pp. Sept. 16, 3,000; Apr. 23, 500; May 17, 5,000	8,500
No. 412. Object Lesson Roads. Logan Waller Page. (From Ybk., 1906.) 16 pp. June 4	200
Farmers' Bulletins:	
No. 235. Cement Mortar and Concrete: Preparation and Use for Farm Purposes. Philip L. Wormeley, jr. 32 pp. July 24, 10,000; Sept. 21, 10,000; Dec. 15, 10,000; Feb. 27, 10,000; May 28, 15,000	55,000

Publications issued during the year ended June 30, 1909—Continued.

Farmers' Bulletins—Continued.	Copies.
No. 239. The Corrosion of Fence Wire. Allerton S. Cushman. 31 pp. June 11	15,000
No. 311. Sand-Clay and Burnt-Clay Roads. W. L. Spoon. 21 pp. July 21, 10,000; Sept. 10, 15,000; Apr. 19, 20,000	45,000
No. 321. Use of Split-Log Drag on Earth Roads. D. Ward King. 16 pp. Aug. 10, 25,000; Sept. 23, 30,000; Feb. 25, 15,000; Mar. 15, 35,000	105,000

BUREAU OF SOILS.

NEW PUBLICATIONS.

Bulletins:	
No. 52. Absorption by Soils. H. E. Patten and W. H. Waggaman. 95 pp. 15 cts. Aug. 10	3,000
No. 53. The Isolation of Harmful Organic Substances from Soils. Oswald Schreiner and E. C. Shorey. 53 pp. 15 cts. Apr. 7	3,000
No. 54. The Mineral Composition of Soil Particles. G. H. Failyer, J. G. Smith, and H. R. Wade. 36 pp. 20 cts. Dec. 31	3,000
No. 55. Soils of the United States Based Upon the Work of the Bureau of Soils to Jan. 1, 1908. Milton Whitney. 243 pp. 45 cts. Feb. 10	1,000
No. 56. The Rôle of Oxidation in Soil Fertility. Oswald Schreiner and Howard S. Reed. 52 pp. 10 cts. Mar. 6	3,000
Annual Report:	
Report of Chief of the Bureau of Soils, 1908. Milton Whitney. (From An. Rpts. of Dept., 1908.) 29 pp. Dec. 17	300
Miscellaneous Circulars:	
List of Publications of the Bureau (revised to February 1, 1909). 32 pp. Feb. 26	5,000
List of Soil Surveys (revised to October 1, 1908). 8 pp. Oct. 20	3,000

EARLIER PUBLICATIONS REPRINTED.

Bulletins:	
No. 22. The Chemistry of the Soil as Related to Crop Production. Milton Whitney and F. K. Cameron. 71 pp. 5 cts. Aug. 31	500
No. 23. Investigations in Soil Fertility. Milton Whitney and F. K. Cameron. 48 pp. 5 cts. Nov. 13	500
No. 24. The Centrifugal Method of Mechanical Soil Analysis. Lyman J. Briggs, F. O. Martin, and J. R. Pearce. 38 pp. 10 cts. Nov. 3	500
No. 30. The Mineral Constituents of the Soil Solutions. F. K. Cameron and J. M. Bell. 70 pp. 5 cts. July 7	300
No. 32. The Absorption of Phosphates and Potassium by Soils. Oswald Schreiner and G. H. Failyer. 39 pp. 10 cts. Nov. 4	500
No. 34. Reclamation of Alkali Soils. Clarence W. Dorsey. 30 pp. 10 cts. Oct. 31	500
No. 35. Alkali Soils of the United States: A Review of Literature and Summary of Present Information. Clarence W. Dorsey. 196 pp. 25 cts. Nov. 12	500
No. 40. Some Factors Influencing Soil Fertility. Oswald Schreiner and H. S. Reed. 40 pp. 10 cts. Aug. 17	500
No. 44. Reclamation of Alkali Soils at Billings, Mont. Clarence W. Dorsey. 21 pp. 10 cts. Nov. 3	500
No. 48. Fertility of Soils as Affected by Manures. Frank D. Gardner. 59 pp. 10 cts. July 9, 500; Aug. 4, 500	1,000
No. 50. Moisture Content and Physical Condition of Soils. F. K. Cameron and F. E. Gallagher. 70 pp. 15 cts. July 10, 1,000; Aug. 10, 500	1,500
Circular:	
No. 18. The Wire-Basket Method for Determining the Manurial Requirements of Soils. 6 pp. Oct. 3, 1,000; Jan. 15, 1,000	2,000
Farmers' Bulletins:	
No. 60, 2d revision. Methods of Curing Tobacco. 23 pp. Nov. 10	10,000

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
Farmers' Bulletins—Continued.	
No. 82. The Culture of Tobacco. O. C. Butterweck. 24 pp. July 29, 10,000; Nov. 5, 10,000; May 26, 10,000	30,000
No. 83. Tobacco Soils. Milton Whitney. 23 pp. Sept. 23, 10,000; Mar. 26, 10,000	20,000
No. 88. Alkali Lands. Milton Whitney and T. H. Means. 24 pp. July 22, 10,000; May 24, 5,000	15,000
No. 257. Soil Fertility. Milton Whitney. 39 pp. Nov. 12, 10,000; Feb. 25, 10,000; May 10, 15,000	35,000
No. 266. Management of Soils to Conserve Moisture with Special Reference to Semiarid Conditions. Geo. H. Failyer. 32 pp. Nov. 13, 10,000; Mar. 29, 10,000; June 17, 10,000	30,000

BUREAU OF STATISTICS.

New Publications.

Bulletins:	
No. 57, revised. Wheat Crops of the United States, 1866–1906. 39 pp. 10 cts. Oct. 19	1,500
No. 64. Number and Value of Farm Animals in the United States, 1867–1907. 145 pp. 15 cts. July 7	1,000
No. 70. Imports of Farm and Forest Products, 1905–1907, by Countries from Which Consigned. 62 pp. 10 cts. Jan. 12	3,800
No. 71. Exports of Farm and Forest Products, 1906–7, by Countries to Which Consigned. 78 pp. 10 cts. Nov. 10	3,800
No. 72. Agricultural Imports of the Netherlands. 53 pp. 10 cts. Jan. 28	4,000
No. 73. The Cost of Producing Minnesota Farm Products, 1902–1907. E. C. Parker and T. P. Cooper. 69 pp. 15 cts. May 1	6,000
Circular:	
No. 17. Government Crop Reports: Their Value, Scope, and Preparation. C. C. Clark. 16 pp. Sept. 30	52,000
Annual Report:	
Report of Acting Chief, Bureau of Statistics, for 1908. Chas. C. Clark. (From An. Rpts. of Dept., 1908.) 12 pp. Nov. 7	1,000
Yearbook Extracts:	
No. 449. Traffic on Chesapeake Bay and Tennessee River. Frank Andrews. (From Ybk. 1907.) 19 pp. Aug. 5, 3,000; Sept. 2, 1,000	4,000
No. 465. Agricultural Statistics, 1907. (From Ybk. 1907.) 156 pp. Aug. 5	10,000
Crop Reporter (a two-column quarto devoted to agricultural statistics):	
Vol. 10, No. 7; July, 1908. 8 pp. July 18	135,000
Vol. 10, No. 8; August, 1908. 8 pp. Aug. 17	130,000
Vol. 10, No. 9; September, 1908. 8 pp. Sept. 15	131,000
Vol. 10, No. 10; October, 1908. 8 pp. Oct. 17	136,000
Vol. 10, No. 11; November, 1908. 8 pp. Nov. 17	133,000
Vol. 10, No. 12; December, 1908. 8 pp. Dec. 14	135,000
Vol. 10, No. 12; Supplement. 8 pp. Dec. 26	136,000
Vol. 11, No. 1; January, 1909. 8 pp. Jan. 14	128,000
Vol. 11, No. 2; February, 1909. 8 pp. Feb. 6	129,000
Vol. 11, No. 3; March, 1909. 8 pp. Mar. 13	130,000
Vol. 11, No. 4; April, 1909. 4 pp. Apr. 10	130,000
Vol. 11, No. 5; May, 1909. 4 pp. May 11	130,000
Vol. 11, No. 6; June, 1909. 8 pp. June 12	135,000
Index to Crop Reporter, Volumes 8–10. 15 pp. July 28	5,000

Earlier Publications Reprinted.

Bulletin:	
No. 39. Meat in Foreign Markets: Tariffs of Fourteen Importing Nations, and Countries of Surplus. 95 pp. 5 cts. Apr. 24	500
Yearbook Extract:	
No. 421. Foreign Restrictions on American Meat. Frank R. Rutter. (From Ybk. 1906.) 20 pp. Apr. 9	700

Publications issued during the year ended June 30, 1909—Continued.

WEATHER BUREAU.[a]

NEW PUBLICATIONS.

	Copies.
Bulletins:	
R. The Daily Normal Temperature and Daily Normal Precipitation of the United States. Frank H. Bigelow. 186 pp. $1.75. Nov. 4	1,000
S. Report of the Temperature and Vapor Tensions of the United States, Reduced to a Homogeneous System of 24-hourly Observations for the 33-year Interval, 1873–1905. Frank H. Bigelow. 302 pp. $1.15. Apr. 27	1,000
Bulletin of the Mount Weather Observatory[b] (quarterly):	
Vol. I, Part 3. 74 pp. Aug. 4	1,200
Vol. I, Part 4. 77 pp. Jan. 9	1,200
Vol. II, Part 1. 54 pp. Mar. 10	900
Circular:	
F, 3d edition. Barometers and the Measurement of Atmospheric Pressure. 110 pp. 10 cts. Jan. 23	1,000
Annual Report:[c]	
Report of the Chief of the Weather Bureau for 1908. Willis L. Moore. (From An. Rpts. of Dept., 1908.) 32 pp. Dec. 14	1,000
Yearbook Extract:[c]	
No. 471. The Weather Bureau and the Public Schools. John R. Weeks. (From Ybk. 1907.) 11 pp. Sept. 24	3,000
Miscellaneous:	
Daily River Stages at River Gage Stations on the Principal Rivers of the United States. Part VIII, for the years 1905 and 1906. H. C. Frankenfeld. 270 pp. $1.75. Mar. 3	500
A Manual for Observers in Climatology and Evaporation. Frank H. Bigelow. 106 pp	1,000
Instructions to Marine Observers of the Weather Bureau. Henry L. Heiskell. 48 pp. Nov. 20	3,000
Daily Weather Map,[d] Washington, D. C. Average daily edition, 1,300	474,055
Monthly Weather Review[e] (quarto):	
Vol. XXXVI, No. 5, May, 1908. 35 pp., 7 charts. Aug. 10	4,800
Vol. XXXVI, No. 6, June, 1908. 35 pp., 6 charts. Aug. 31	4,800
Vol. XXXVI, No. 7, July, 1908. 34 pp., 6 charts. Sept. 18	4,800
Vol. XXXVI, No. 8, August, 1908. 43 pp., 9 charts. Nov. 5	4,800
Vol. XXXVI, No. 9, September, 1908. 50 pp., 9 charts. Nov. 18	4,800
Vol. XXXVI, No. 10, October, 1908. 32 pp., 7 charts. Dec. 23	4,800
Vol. XXXVI, No. 11, November, 1908. 37 pp., 8 charts. Jan. 20	4,800
Vol. XXXVI, No. 12, December, 1908. 40 pp., 9 charts. Feb. 15	4,800
Vol. XXXVI, No. 13, Annual Summary, 1908. 54 pp., 6 charts, May 4	4,800
Vol. XXXVII, No. 1, January, 1909. 42 pp., 11 charts. Apr. 10	4,800
Vol. XXXVII, No. 2, February, 1909. 42 pp., 8 charts. May 17	4,800
Vol. XXXVII, No. 3, March, 1909. 39 pp., 9 charts. June 28	4,800

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[a] This list contains only the important publications issued by the Washington Office of the Weather Bureau. For an account of other publications, see page 595.

[b] Subscription price 25 cents per number, or $1 per year.

[c] Contributed by the Weather Bureau, but issued by the Department through the Division of Publications.

[d] A single sheet (19 by 24 inches) printed on one side, containing a weather map, a table of temperature, rainfall, and other data for the entire United States, and forecasts for the eastern districts. Subscription price, 25 cents per month, or $2.50 per year.

[e] Subscription price, 20 cents per number, or $2.50 per year.

Publications issued during the year ended June 30, 1909—Continued.

	Copies.
National Weather Bulletin[a] (Reporting Temperature and Rainfall, with a Summary of Weather Conditions by Sections throughout the United States):	
No. 16, for the week ended July 6	2,250
No. 17, for the week ended July 13	2,250
No. 18, for the week ended July 20	2,250
No. 19, for the week ended July 27	2,250
No. 20, for the week ended August 3	2,250
No. 21, for the week ended August 10	2,250
No. 22, for the week ended August 17	2,250
No. 23, for the week ended August 24	2,250
No. 24, for the week ended August 31	2,250
No. 25, for the week ended September 7	2,250
No. 26, for the week ended September 14	2,250
No. 27, for the week ended September 21	2,250
No. 28, for the week ended September 28	2,550
No. 29, for month of October	2,750
No. 30, for month of November	2,750
No. 31, for month of December	2,750
No. 1, for month of January	2,750
No. 2, for month of February	2,690
No. 3, for month of March	2,750
No. 4, for month of April	2,850
No. 5, for week ended May 17	2,850
No. 6, for week ended May 24	2,850
No. 7, for week ended May 31	2,850
No. 8, for week ended June 7	2,950
No. 9, for week ended June 14	2,950
No. 10, for week ended June 21	2,950
No. 11, for week ended June 28	2,950
Snow and Ice Bulletin:[b]	
December 8, 1908	1,275
December 15, 1908	1,275
December 22, 1908	1,350
December 29, 1908	1,350
January 5, 1909	1,350
January 12, 1909	1,350
January 19, 1909	1,350
January 26, 1909	1,350
February 3, 1909	1,350
February 9, 1909	1,350
February 16, 1909	1,350
February 23, 1909	1,350
March 2, 1909	1,350
March 9, 1909	1,350
March 16, 1909	1,350
March 23, 1909	1,350

EARLIER PUBLICATION REPRINTED.

Farmers' Bulletin:[c]	
No. 104. Notes on Frost. E. B. Garriott. 31 pp. Oct. 8, 10,000; Apr. 9, 5,000	15,000

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[a] A single sheet (19 by 24 inches) printed on one side only, containing charts, tables, and reading matter, issued weekly during the crop-growing season and monthly during the remainder of the year. Subscription price, 25 cents per year.

[b] A single sheet (12 by 19 inches) printed on one side, containing map, table, and descriptive matter; issued weekly during the season of ice and snow. Subscription price, 25 cents per year.

[c] Contributed by the Weather Bureau, but issued by the Department through the Division of Publications.

REPORT OF THE CHIEF OF THE BUREAU OF STATISTICS.

U. S. Department of Agriculture,
Bureau of Statistics,
Washington, D. C., September 3, 1909.

Sir: I have the honor to submit herewith the report of the Bureau of Statistics for the fiscal year ended June 30, 1909.

Respectfully,

Victor H. Olmsted,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

ORGANIZATION.

The organization of the Bureau of Statistics of the Department of Agriculture at the close of the fiscal year ended June 30, 1909, included, in Washington, a Statistician, who is Chief of Bureau, an Assistant Statistician, a chief clerk, and three divisons—the Division of Domestic Crop Reports, the Division of Production and Distribution, and the Editorial Division and Library—each of which is directed by a chief of division under the administrative control of the Chief of Bureau. In addition, the organization includes a corps of special field agents, another of state statistical agents, and several classes of voluntary correspondents, who supply the Bureau with information upon which its monthly reports are based.

On October 16, 1908, Mr. Victor H. Olmsted resumed his duties as Statistician and Chief of Bureau, having completed the work to which he had been detailed in connection with the taking and compiling of the census of Cuba, in which he had been engaged since April, 1907. During his absence Mr. C. C. Clark, the Associate Statistician, served as Acting Chief of Bureau and chairman of the Crop Reporting Board. The services of the Associate Statistician were interrupted by his absence from the Bureau from October 8 to December 13, 1908, during which period he served as a delegate of the United States to the first meeting of the General Assembly of the International Institute of Agriculture, at Rome, Italy, and from March 16, 1909, on which date he departed for Rome, where he has since been located, having been appointed chief of the statistical division of the Institute.

DIVISION OF PRODUCTION AND DISTRIBUTION.

The division formerly known as the Division of Foreign Markets was changed in name to the Division of Production and Distribution during the fiscal year ended June 30, 1908. It is a division of special research and investigation in directions heretofore slightly, if at all, explored. It has originated a general survey of agricultural conditions and accomplishments in the United States, composed of the more important elements of production, in quantity and value; of national surplus, deficiency, and consumption; of farm wealth and labor; and of agricultural economic achievement and progress. It is devoting original work to the historical aspect of the agricultural production in the United States of particular products, and is making an extended inquiry into the dates of planting and harvesting a large list of crops in different sections of the United States and in foreign countries.

This division also gives attention to the production of important agricultural commodities by the principal countries of the world below and above their respective requirements for consumption, the sources of the supply of such commodities to countries of deficient production, and the destinations of the surpluses of exporting countries.

The trend of events in recent years has rendered the future supplies of wheat and of meat problems of world-wide concern. A large amount of varied information concerning wheat and meat has been collected and published, and constant efforts are made to bring the data concerning them to date.

The transportation of agricultural products from farm to consumer by wagon, rail, and water is a special subject to which much original work has been given in this division. It is accumulating information relating to farmers' cooperative associations for production, selling, and buying; for fire, live-stock, and other insurance; for warehousing; for performing telephone services; and for promoting mutual helpfulness. Matters of economic significance in the production of wealth on farms and in the disposal of products afford a wide range for work in this division in directions not previously pursued.

In the permanent literature of agriculture constant need is felt for formulated statements of the quantity and value of the domestic products of agriculture exported and imported as far back as the middle of the nineteenth century; and on account of the widespread interest in forestry similar data are demanded concerning forest products. The need for this information has been met by the preparation of three bulletins which can be kept to date hereafter by yearly supplementary work.

Along the lines of work pursued, permanent results are established of frequent utility to the offices of the Department of Agriculture, to the many applicants for information outside of the Department, and to the general public. During the past five years this division has issued thirty-four bulletins, thirty-two of which are in current demand, and seven special articles of continuing service have been prepared for the Yearbook of this Department, in addition to many statistical tables of permanent value, contributed to the agricultural statistics of the Yearbook, which are brought to date annually.

EDITORIAL DIVISION AND LIBRARY.

The functions of the Editorial Division and Library are indicated by the character of work performed during the past year, which may be summarized as follows: (1) The Bureau's editorial service; (2) research in domestic and foreign statistical and economic literature for data required both for publication and for meeting the constantly increasing demand therefor from public functionaries and institutions and from private individuals; (3) the conduct of a portion of the Bureau's voluminous correspondence, bearing chiefly upon agricultural subjects; (4) the administration of the Bureau library; (5) translation, stenography, and typewriting.

The editorial work has consisted of editing all manuscript prepared for publication in the Bureau during the year. This has comprised nine bulletins, of which four have been issued and five are now ready for the press; the twelve monthly editions of the Crop Reporter, the official organ of the Bureau; and the statistical tables prepared in the Bureau for the 1908 Yearbook of the Department and also published separately under the title "Agricultural Statistics."

Research work has been conducted during the year along the customary lines; extensive investigations, bearing more or less directly upon various phases of the world's agriculture, have resulted in the accumulation of valuable material for publication, and much research of a less extensive but more diverse character has been directed to compilations of statistics requested by statesmen, statisticians, educators, publishers, economists, and business men in general. Investigations conducted in the division the results of which have been or will be published are the Bureau's regular annual statements, by countries, of the world production of corn, wheat, oats, barley, rye, flax, and flaxseed; initial statements, for future publication, of the areas devoted annually to each of these crops in all countries for which official statistics are obtainable; the world production of coffee, by countries, together with the world commerce therein for a long period of years, with particular reference to the consumption and trade of the United States; and the commerce in and consumption of cocoanut oil and cocoanut-oil cake.

A portion of the Bureau's correspondence, which requires the compilation of statistical data and preparation of letters of reply, is allotted to this division. This work, as a whole, has involved research in official and nonofficial statistics of different countries concerning the extent, value, and tenure of their cultivated lands; the distribution of crops thereon; the number of people engaged in agriculture; the number and value of live stock; crop yields; cost of production; prices of agricultural commodities in domestic and foreign markets; domestic consumption of and external and internal commerce in various farm products; duties upon imports thereof; bounties upon production; and a great variety of allied subjects relating to the various details of domestic and foreign agriculture.

The Bureau library, which contains upward of 10,000 volumes and pamphlets devoted more or less exclusively to statistics of agriculture, has had a normal growth during the year. Through exchange with the statistical organizations of foreign, federal, state, and municipal governments additions have been made to the shelves of their latest official publications upon agriculture and the trade in agricultural products. The regular issues of foreign and domestic statistical trade journals, market reports, reports of commercial exchanges, and price lists have been added to the files during the year, thereby completing up to the present a useful and permanent record of price statistics and other valuable data not obtainable from other sources. The library now represents probably as comprehensive, complete, and up-to-date a collection of statistics on the agriculture of the world—especially of statistics relating to land cultivated and crops produced—as is possessed by any government. In the administration of the library the constant endeavor has been to make the wealth of statistical data it contains easily and readily accessible. Through systematic arrangement, classification, and a continuous extension of the card-index system, steady progress has been made toward the attainment of this end.

In translation, stenography, and typewriting considerable service has been rendered other branches of the Department in addition to the routine work of the division.

DIVISION OF DOMESTIC CROP REPORTS.

The most important work of the Bureau of Statistics consists, as it has for nearly half a century, in the collection of data from month to month for use as bases of the Bureau's estimates relating in different months to the areas, conditions, yields, and values of various principal crops; to the conditions and prospects of many minor crops; and, annually, to the number and value of the different classes of farm animals, and the loss of such animals through disease or exposure. The monthly estimates of the Bureau relating to the various subjects are published in comparison with similar estimates made at corresponding dates in preceding years.

The first monthly crop condition reports were issued in 1863, since when the work has gradually expanded and enlarged to its present scope.

Approximately four-fifths of the total appropriation for the Bureau has been expended in making monthly crop reports, including the collection of data, their tabulation and computation, and the preparation and publication of the Bureau's monthly estimates based thereon.

The Division of Domestic Crop Reports performs a large proportion of this work, which includes the preparation and mailing to the separate classes of the Bureau's agents, each month, of all schedules of inquiry relating to the various subjects dealt with during different portions of the year. The reports of the different classes of voluntary correspondents of the Bureau, as distinguished from salaried agents (except those reports sent directly to special field agents, state statistical agents, and county correspondents by their respective aids), are received in the Bureau and distributed to employees in different sections of this division, by whom they are tabulated and computed, the results being reported to the Statistician and to the Crop Reporting Board for use in making the Bureau's monthly estimates.

In this division the correspondence with voluntary crop reporters relating to their work is conducted; and the lists of such correspondents are recorded and maintained, the names of such of them as have ceased to supply reports being eliminated and new correspondents being added every month. Much is also accomplished in this division, when the pressure of work incident to the duties above mentioned does not prevent, in making tabulations of statistical data for publication in the Yearbook of the Department of Agriculture or in bulletins, and in making computations and preparing tabular matter for other divisions of this Bureau and other Bureaus of the Department.

The increased number of agricultural products dealt with, as compared with former years, has required the adoption of improved and simplified methods of tabulation and computation by the Division of Domestic Crop Reports in order to enable the clerical force to handle promptly the monthly reports received from the Bureau's correspondents. The successful installation of these improved methods has enabled the division not only to compile the additional data, but also to complete its work in time to permit the issuance of the Bureau's monthly estimates from one to two days earlier than was formerly possible.

SOURCES OF INFORMATION.

The information upon which the monthly estimates of the Bureau are based is derived from two general sources, namely, salaried agents and voluntary correspondents. The voluntary correspondents are public-spirited citizens who serve without compensation other than such available publications and seeds as can be supplied them, of which the Bureau has not had at its disposal in recent years adequate quantities to fully and properly meet their wishes and requests.

The salaried agents of the Bureau consist of special field agents and state statistical agents.

SPECIAL FIELD AGENTS.

Nineteen special field agents were employed during the year; of these sixteen were engaged in collecting the agricultural data required from month to month regarding the various subjects dealt with in their respective territories; one in collecting information regarding tobacco throughout the United States; one in gathering information as to rice; and one was engaged during the first six months of the year collecting data regarding rural schools in connection with instruction in agriculture. These agents devoted their entire time to the work intrusted to them, it being their duty to travel throughout the more important agricultural sections of the territories assigned them respectively to secure reliable information through intercourse with farmers and others conversant with agricultural conditions, and through personal investigations of crops in the fields; also each one of them has well-informed correspondents in the different sections of their respective territories, who supply them with information which they utilize to supplement that which they have collected personally in making their monthly reports.

In addition to the nineteen special field agents above mentioned, employed in the United States, a special agent was employed during the first half of the year in Europe, with headquarters at London, England, in gathering information regarding European crops, which was published each month in the Crop Reporter.

As the fiscal year advanced, it was found that the funds at the disposal of the Bureau were not sufficient to permit the special field agents to incur the expense necessary to the full amount of travel they ought to perform, and, in order to correct this condition as far as possible, the special European agent was recalled in January, 1909, and in the same month the collection of data regarding rural schools was discontinued; the agent engaged in the work last referred to resigned, as well as one other special field agent, and no successors were appointed, the funds saved by their severance from the Bureau being needed in carrying on the work of the remaining agents and in defraying the general expenses of the Bureau. At the close of the fiscal year seventeen special field agents were employed, their respective territories being as follows: (1) The New England States and New York; (2) Pennsylvania, Delaware, New Jersey, Maryland, and West Virginia; (3) Virginia, North Carolina, and South Carolina; (4) Georgia and Florida; (5) Michigan, Ohio, Indiana, Illinois, and Kentucky; (6) Tennessee, Alabama, and Mississippi; (7) Minnesota, North Dakota, and South Dakota; (8) Wisconsin, Iowa, and Nebraska; (9) Kansas and Missouri; (10) Arkansas and Louisiana; (11) Oklahoma and a part of northern Texas contiguous thereto; (12) Texas, except the northern part of the State contiguous to Oklahoma; (13) Colorado, Utah, and Wyoming; (14) Washington, Oregon, and Idaho; (15) California; (16) the tobacco-growing sections of the United States; (17) the rice-growing sections of the United States.

STATE STATISTICAL AGENTS.

There were forty-four state statistical agents employed during and at the close of the fiscal year. Each of these agents reports for the State, as a whole, in which he is located; he maintains a list of voluntary correspondents who report to him monthly, using schedules of inquiry similar to those used by other correspondents and agents. The reports he secures from these correspondents, combined with his own knowledge and observation, form the bases of his monthly telegraphed or written reports, which are utilized by the Bureau in making its monthly estimates.

During the year state statistical agents in important agricultural States were authorized to perform a limited amount of travel through the principal farming sections of their respective States, it having been found that their efficiency and work have been greatly benefited and strengthened thereby. Their journeys accomplished the purpose of giving them opportunities to personally observe and investigate agricultural conditions and incidentally to come into contact with many of their correspondents as well as to select and enlist new ones. When available funds permit, this class of agents will be authorized to travel hereafter more frequently and extensively than in the past.

VOLUNTARY CORRESPONDENTS.

There are several classes of voluntary correspondents, principally farmers, who serve without monetary compensation. There were, during the year, approximately, 135,000 voluntary correspondents, including those of state statistical agents and of county correspondents, to whom schedules of inquiry were sent.

In the United States there are about 2,800 counties classed as agricultural, and in practically all of these the Bureau has county correspondents, one in each county, who are selected with reference to their fitness for making crop reports, each of whom has two or more correspondents in different sections of the county who aid him in the service he renders by reporting directly to him. The county correspondents report each month for their respective counties as a whole, sending their reports directly to the Bureau and combining the information received from their correspondents with their own knowledge and observation.

The Bureau has also a list of about 33,000 township correspondents located in agricultural townships, voting precincts, and other minor civil divisions, who are called on for monthly reports directly to the Bureau, covering the territories in which they are located.

A list is maintained of about 25,000 individual farmers who are called upon after the close of the growing season each year for reports as to the results of their personal farming operations; and data regarding wheat are obtained from grain dealers and elevator men throughout the country. Special lists of tobacco, rice, and cotton correspondents are utilized in securing information regarding the crops specified; and inquiries are sent to all cotton ginners, and to a list of individual farmers in the cotton producing States, twice each year, regarding the acreage and yield of cotton.

The reports received from each class of voluntary correspondents are tabulated and computed in the Division of Domestic Crop Reports. Each class of reports is handled separately from and independent of every other class.

CROP REPORTING BOARD.

Prior to 1905 the monthly crop estimates of the Bureau were made by one person, the Chief of Bureau. This method had some unsatisfactory features, and in the year mentioned a different plan was adopted, in accordance with which the making of the estimates of important crops was intrusted to a Crop Reporting Board. This plan has been continued, having been found to give more satisfactory results than were secured by the method previously followed.

The Crop Reporting Board is composed of five persons, including, as permanent members, the Chief of Bureau, who is chairman of the board, the Assistant Chief of the Bureau, and an expert statistician in the employ of the Bureau; and two changeable members—special field agents or state statistical agents—who are called to Washington for this service in preparing each crop report. It has been found that the consensus of judgment secured under this system has given increased confidence in the Bureau's estimates, and that it has removed all question or suggestion of improper influence or bias.

The reports of the field and state agents, and the separate tabulated results of the reports of the different classes of voluntary correspondents, conveniently arranged in parallel columns by States, are placed before the individual members of the board, each of whom considers them independently, without consulting any other member, and makes an estimate for each State regarding each subject dealt with. These independent estimates are then considered by the entire board under the supervision of the chairman, and final figures for each State are decided upon, which are weighted in accordance with the relative importance of the respective States, the result being a true weighted average for each subject for the United States. In preparing the estimates it has been found that the reports of the different classes of correspondents and agents are often identical, or approximately so, and that the independent estimates of the individual members of the board, when not exactly identical, usually agree very closely, thus enabling the board, as a rule, to decide upon the figures of the estimates, as finally made and published, without difficulty.

The meetings of the board are held behind locked doors in the office of the Chief of Bureau, all telephones being disconnected and no one being allowed to enter or leave other than the Secretary or Acting Secretary of Agriculture.

ISSUANCE OF CROP REPORTS.

In order that the Bureau's estimates may be made public in all parts of the United States simultaneously, multigraphed summaries are given, at a definite time previously announced, to representatives of the press and the telegraph companies, and to others who may apply for them; and summaries are mailed to exchanges, newspapers, and individuals. Each monthly estimate regarding cotton is printed on cards, with comparative data, the same day on which the estimate is made, and these are mailed immediately to all post-offices in the cotton producing States, to be posted conspicuously therein for the information of the public.

CROP REPORTER.

As soon as possible, within three or four days after each estimate has been promulgated as above described, the detailed data are published, together with information regarding crops in foreign countries and other statistical matter relating to agriculture, in the Crop Reporter, a publication usually of eight pages, issued monthly by the Bureau of Statistics for distribution among the Bureau's correspondents and others throughout the United States who desire it. An average edition of about 133,000 copies of this publication was printed each month during the year.

The form in which the reports are prepared and published has been improved considerably, the information they give being much more full and complete than formerly. The figures each month relating to any crop or product are placed in comparison with those for the corresponding month of the preceding year or years, and are given to the public in such form that their significance can be readily understood without the necessity of looking up elsewhere figures for the preceding years.

SCOPE OF CROP REPORTS.

During the course of a year eleven monthly reports are received from correspondents and agents of the Bureau in response to general schedules of inquiry relating, in different months, to the acreage, condition, or production of various crops, or the numbers, status, or values of farm animals. Also, inquiries are made each month regarding the farm prices of many agricultural products, the list of which was increased during the year by the addition of questions relative to the prices received by farmers on the first of each month for butter, eggs, and chickens.

The cotton crop is dealt with separately from the other crops. Six reports upon this crop are made during the year; the first relates to acreage and condition, the last to yield, and the intermediate reports to the condition of the growing crop. In the first and last of the reports regarding cotton (relating to acreage and production, respectively) the regular sources of information are supplemented by reports received from individual farmers, special correspondents, and cotton ginners.

The reports received in reply to the inquiries embraced by the general and special schedules referred to above constitute the bases of the Bureau's monthly estimates. A description of the principal features of each of the separate monthly reports was given in the annual reports of this Bureau for the fiscal years 1905 and 1907.

In addition to the crops formerly reported upon from month to month, the schedules have been extended during the past three years to embrace many minor crops, including fruits and vegetables, and the monthly farm prices of important crops. The reports relating to minor crops have consisted principally of information in regard to their condition during the growing season, thereby enabling growers, dealers, and others interested in them to gain an idea as to their general prospects—that is, whether bountiful, moderate, or meager crops were to be expected. Information has also been given regarding the relative production of minor crops—that is, the proportion expressed in percentages, in comparison with full crops.

The six special reports of correspondents and agents regarding cotton are made near the close of May, June, July, August, September, and November. The Bureau's estimates, based on these reports, are promulgated early in each of the succeeding months.

The total number of subjects concerning which the Bureau made estimates during the year was fifty-six (56), in addition to six classes of farm animals, as follows:

Cereals: Corn, spring wheat, winter wheat, oats, rye, barley, buckwheat, rice.

Forages: Alfalfa, bluegrass (seed), hay (all), clover hay, clover seed, timothy, kafir corn, meadow mowing lands, pastures, millet.

Fruits: Apples, blackberries, cantaloupes, cranberries, grapes, lemons, oranges, peaches, pears, raspberries, strawberries, watermelons.

Vegetables: Asparagus, beans (dry), beans (lima), cabbages, onions, potatoes, sweet potatoes, tomatoes.

Miscellaneous: Cotton, Canadian (field) peas, cowpeas, broom corn, flaxseed, hemp, hops, peanuts, sorghum, sugar beets, sugar cane, tobacco, wool, butter, eggs, chickens, plowing, planting.

Farm animals: Horses, mules, milch cows, other cattle, sheep, swine.

SPECIAL REPORTS.

From time to time, as facilities and opportunity permit, special inquiries are made regarding agricultural matters of interest not embraced by the regular schedules.

In response to a demand for special information regarding the production of tobacco, the efforts of the Bureau resulted in securing, for the first time, data relating to the various types of the tobacco crop, and in the Crop Reporter for January, 1909, a statement was published showing the estimated production of the 1908 tobacco crop, by types, together with the percentage of each type marketed up to December 20, 1908, and the average farm value on December 1, 1908 and 1907, of each type.

During the latter part of the calendar year 1908 special inquiry was made of mills and elevators as to the proportions marketed each month of the total amount marketed by farmers of grain and hay crops, during the year ended June 30, 1908. The results of the inquiry, which were published in the Crop Reporter for January, 1909, served to indicate the relative movements from month to month of the crops reported upon in important agricultural States.

In February, 1909, the results of a special inquiry among potato growers and interior dealers in the principal potato growing sections were published regarding stocks on hand January 1, 1909, which indicated the proportion of the potato crop of 1908 held by growers and dealers on that date, and the proportional quantity then held for market as compared with that held on January 1, 1908, in the principal potato growing States.

A special inquiry was made regarding the stocks of hay on farms on May 1, 1909, and the proportion of the hay crop to be fed on the farms where produced, and to be moved off the farms. The results were published in the Crop Reporter for May, 1909.

STATISTICAL MATTER FOR YEARBOOK.

An important branch of work carried on from year to year consists in the assembling of statistical data relating to agriculture, drawn from the original estimates of this Bureau and other available reliable sources, for annual publication in the Yearbook of the Department of Agriculture, and for general circulation in separate form as reprints from the Yearbook.

The statistics cover about 150 pages of closely printed tabular matter embracing a wide range. An idea of their general scope may be had from the following outline of those relating to corn, information of like character being given for other principal crops:

The estimated corn crops of all countries of the world for which figures are obtainable, expressed in bushels, are given by great geographical divisions (as North America, South America, Europe, etc.) and by separate countries (as United States, Canada, Mexico, etc.); for the United States as a whole, for each of a series of years, the total acreage and production, the average yield per acre, the average farm price per bushel, and total farm value, the market value, the quantity exported, and the monthly condition of the growing crop; and, for each State for the current year, the total acreage, production, value, quantity remaining in farmers' hands on March 1, and the quantity shipped out of the counties where grown; and, for each of a series of years, the average yield per acre and the average farm value per acre and per bushel. The low and high wholesale prices per bushel in different leading markets are shown for each month; and the international trade in corn, showing the exports and imports of the principal corn-producing and corn-consuming countries of the world, is given for each of a series of years.

Among the various products concerning which statistics more or less extensive are compiled for the Yearbook, in addition to corn, are wheat, oats, barley, rye, buckwheat, potatoes, hay, tobacco, rice, flaxseed, clover and timothy seed, hops, farm animals of different classes, live-stock products, such as hides, skins, wool, dairy products, etc.

Two valuable and convenient statistical tables embraced by these compilations are statements showing in detail the quantities and values of imports and exports, respectively, by the United States of every kind of agricultural product for each of the last five years.

COST OF PRODUCING FARM PRODUCTS.

The investigations made by this Bureau, in cooperation with the Minnesota Agricultural Experiment Station, relating to the cost of producing agricultural products in Minnesota, which were originated and organized in 1902, have been carried on continuously since their beginning in that year, with the object of ascertaining (1) the cost to the farmer of the production of various crops under normal conditions on private farms; (2) the cost of different systems of farm management; and (3) the cost of experimental crop rotation; also with the object of devising methods for the statistical study of farming operations and farm life.

The statistics obtained for the years 1902, 1903, and 1904, and the conclusions based thereon, together with a careful explanation of the methods employed in carrying on the investigations, were published in a bulletin of this Bureau in 1906; and another bulletin published in 1909 gave the figures and findings for the years 1905, 1906, and 1907, which were combined with those for the earlier years.

A project has been formulated for making investigations along the lines above indicated in a dry-land agricultural section in Colorado and in irrigation sections of Colorado, Nevada, and Washington, to be carried on by this Bureau in cooperation with the States named and with the Bureau of Plant Industry of this Department. The project contemplates that each State shall bear one-third of the cost of the work in its territory, and that the remaining two-thirds shall be borne equally by this Bureau and the Bureau of Plant Industry. The total annual cost of carrying the project into effect is estimated as $6,000, of which this Bureau's quota is $2,000. Should the Congress make the necessary appropriation, steps will be taken looking to the collection of data in accordance with the project. The results secured in Minnesota have been so instructive and valuable as to fully justify investigations of the cost of agricultural production in other States under different conditions.

REVISION OF CROP-ACREAGE ESTIMATES.

The Bureau's annual estimates of crop acreages in the United States are based on estimated percentages of increase or decrease each year, as compared with the acreages estimated for the preceding year. While these estimates, comparing one year with another, may approximate the facts with sufficient closeness to entitle them to credit and to render them useful, they are, nevertheless, likely to be affected in a few years by the tendency on the part of those who supply the information upon which they are based to underestimate or overestimate the increase or decrease in acreage of the separate crops reported upon, so that at the end of several years the estimates may not be in accord with the real figures.

As soon as the results of the Thirteenth Census are available—which will show the acreages, yields, and values of crops in 1909, and the acreages in 1910—this Bureau will be able to thoroughly revise and readjust its estimates for 1909 and 1910, and thus secure more accurate bases upon which to estimate percentages of increase or decrease in acreage in succeeding years.

QUINQUENNIAL AGRICULTURAL CENSUSES.

The recently enacted law making provision for the Thirteenth and subsequent censuses provides, in addition to the regular decennial censuses to be taken in 1910 and every ten years thereafter, "that there shall be in the year 1915 and once every ten years thereafter a census of agriculture and live stock which shall show the acreage of farm lands, the acreage of the principal crops, and the number and value of domestic animals on the farms and ranges of the country. * * * Such census shall be taken as of October 1 and shall relate to the current year." Thus, quinquennial agricultural censuses are provided for, and the Bureau of Statistics will be able to readjust its estimates every five years instead of being compelled to wait ten years, as in the past, for the figures ascertained by decennial censuses. It is apparent that this must necessarily result beneficially and increase the accuracy and value of the yearly estimates of acreage and production.

PUBLICATIONS.

Reference has already been made to some of the Bureau's publications issued or prepared for issuance during the fiscal year ended June 30, 1909. Those issued during the year consisted of the Crop Reporter and four bulletins, in addition to statistical data relating to agriculture published in the Yearbook. The Crop Reporter is the official monthly publication of the Bureau, in which are printed its crop estimates and other agricultural information, of which a total of about 1,600,000 copies were issued.

The bulletins issued during the year gave statistics, as indicated by their titles, as follows: "Imports of Farm and Forest Products, 1905–1907, by Countries from which Consigned;" "Exports of Farm and Forest Products, 1905–1907, by Countries to which Consigned;" "Agricultural Imports of the Netherlands;" and "Cost of Producing Minnesota Farm Products, 1902–1907."

In addition, five bulletins were completed, ready for publication, to be issued as soon as possible after July 1, 1909. These bulletins, which are now in press, deal with the following subjects: (1) "The Foreign Trade of the United States in Forest Products, 1851 to 1908;" (2) "The Exports of Farm Products from the United States;" and (3) "The Imports of Farm Products into the United States from 1851 to 1908"—the three bulletins showing the entire foreign trade of this country in each of the commodities to which they relate for more than a half century; and, (4) "Exports" and (5) "Imports of the United States of Farm and Forest Products, 1906 to 1908," by the countries to and from which exported. Also, for publication in the 1908 Yearbook, an article was contributed on the "Cost and Methods of Transporting Meat Animals" in the United States, and a statement was compiled showing, for the United States, the production, exports, and imports of tobacco, beginning with the year 1612 and continuing without detrimental omissions to 1908.

The preparation of several other bulletins was begun, most of which are to be completed during the present fiscal year, including the regular annual statistics of imports and exports of farm and forest products; the chronology of United States agriculture; dates of crop planting and harvesting throughout the world; new sources of cotton supply; Pacific coast export movement; Balkan agriculture and crop surplus.

CORRESPONDENCE.

Requests for statistical information regarding agriculture and allied subjects, both in the United States and in foreign countries, are received in constantly increasing numbers from legislators, officials, business establishments, representatives of the press, and individuals. Response is made to all such inquiries, and the desired information is supplied as promptly as possible, if available. A large proportion of the requests are for data not contained in publications of the Department of Agriculture, the compilation of which requires considerable research, in which are utilized the files of commercial and trade journals, reports of boards of trade and chambers of commerce, state reports, consular reports, foreign agricultural reports, and reports of other Departments of the United States Government in the Bureau's statistical library.

WORK OF THE BUREAU DURING THE FISCAL YEARS ENDING JUNE 30, 1910 AND 1911.

During the current fiscal year, and that following, the work of the Bureau of Statistics will be conducted along the same general lines as during the year ended June 30, 1909. In recent years a more effective service has been instituted, as indicated by the annual reports of the Bureau; and the statistics collected, compiled, and published have embraced a wider range than formerly. This has been rendered practicable by moderate increases in appropriations from year to year. The appropriation for the year ending June 30, 1910, is, however, no larger than that for the preceding year; and the estimate for next year contemplates no increase in the amount. This will, of course, prevent an enlargement of service or broadening of scope which would involve increased expenditure; but constant effort will be exerted to keep the service up to the highest possible degree of efficiency and to render the varied comprehensive data compiled and issued by the Bureau dependable and serviceable.

RECOMMENDATIONS.

The employment of special field agents has been a valuable adjunct to the crop-reporting service of this Bureau, whose monthly estimates have been strengthened by the information secured through their travel and investigations; but the number of this class of employees is too small, considering the wide agricultural area of the United States, and each of them is, consequently, required to cover larger sections of territory than is consistent with the best obtainable results. The existing condition of the appropriation for the Bureau does not permit an increase in the number of special field agents; but it is hoped that sufficient funds may be appropriated hereafter, from year to year, to make possible a gradual enlargement of this service, until eventually a field agent may be assigned to each of the larger and more important agricultural States, to which he shall devote his entire time and attention.

SUPERVISION OF FIELD AND STATE AGENTS.

It is desirable that the work and methods of the salaried employees of the Bureau whose duties are performed away from Washington should be inspected at comparatively frequent intervals; and that from time to time such personal supervision and instructions should be given them as will result in securing the greatest possible efficiency on their part to the end that their reports regarding agricultural matters may be dependable. It has been found in practice that the best results along these lines can not be secured alone by correspondence, and that the detailed written instructions with which all field agents and state agents are supplied are sometimes misunderstood or not followed by them. No plan of dealing with employees at a distance from headquarters can adequately take the place of personal inspection, supervision, and instruction.

This work can only be accomplished by one who is thoroughly familiar with all the requirements pertaining to the collection of information regarding crop acreages, conditions, and yields, and with a comprehensive knowledge of agricultural statistical methods. No official not conversant with the entire field covered by the work of the Bureau can perform this service properly.

During the greater portion of the year personal inspection and supervision of field and state agents could not be carried on because of the absence from duty of either the Chief of Bureau or the Associate Statistician, as already stated. The constant pressure of work in the Bureau required, and still requires, the unremitting attention of two officials in Washington. It will be advantageous to the service to employ a third official, to be designated as Associate Statistician, or by any other appropriate title, when the available funds of the Bureau will permit, who shall perform the supervision and inspection referred to, or fulfill the duties of the Statistician or Assistant Statistician when either of them is absent.

DISTRIBUTION OF YEARBOOKS TO CORRESPONDENTS.

It has been the custom in past years to supply, as far as possible, the voluntary correspondents of this Bureau, who receive no financial compensation for their services, with available publications of the Department, and with small assortments of garden seeds. Heretofore supplies of publications and seeds have been wholly inadequate to permit compliance with large numbers of their requests, which the Bureau has, therefore, been compelled to deny. Provision has been made for the allotment of a sufficient quantity of seeds to permit a more complete distribution the coming year than formerly; but the number of publications which, under existing circumstances, can be distributed among our correspondents will be insufficient to meet their reasonable requests. This is particularly true regarding the Yearbook of the Department, which is in wide demand, a copy of which should be given to every correspondent desiring it who is asked to supply us with crop reports.

There are few, if any, means by which the valuable information given annually in the Yearbook can be distributed to greater advantage than through the correspondents of this Bureau, most of whom are farmers, whose cooperation and interest in the work of the Department would be sustained and quickened by the recognition of their services which would be given by supplying each of them with a copy of the annual issue of the publication named.

REPORT OF THE LIBRARIAN.

U. S. Department of Agriculture,
Office of the Librarian,
Washington, D. C., September 17, 1909.

Sir: I have the honor to submit herewith the executive report of the Library for the fiscal year ended June 30, 1909.

Respectfully,

Claribel R. Barnett, *Librarian.*

Hon. James Wilson,
Secretary of Agriculture.

WORK OF THE YEAR.

It is gratifying to be able to report continued growth in the several branches of the Library's work. The location of the Library in one of the new laboratory buildings, where it is near to a larger number of laboratories and offices than in previous years, has greatly increased its usefulness. In spite of the increased demands upon the Library staff it has been possible, with one or two exceptions, to keep up to date the routine work, but no new work has been attempted.

ROOMS AND FURNITURE.

On account of the removal of the Library last spring to its new quarters, it was necessary to spend during the past year a larger amount than usual for furniture and fittings. A large map case was provided for the United States Geological Survey topographic sheets and geologic folios. The case has proved very satisfactory and has made this valuable series of maps much more convenient for reference. The periodical workroom was furnished with new oak wall cases, to correspond with the other wall cases in use in the Library, and six additional pigeonhole cases were made for the periodical reading room.

Owing to the crowded condition of the shelves in the classes devoted to agriculture, twenty-four new cases were made to place on top of the metal book cases, thus making use of all space between the floor and the ceiling. On these shelves, which are rather inaccessible on account of their height from the floor, will be stored the files of periodicals less frequently consulted. When the extra space thus provided has been filled it will be a serious problem to provide for the future growth of the Library, as there is no additional room for library shelving in the space at the disposal of the Library.

When the Library was moved last spring to its present location it was estimated that the space assigned to the Library would be sufficient for the collection at that time and for about three years' growth. The present condition of the shelving indicates that this estimate was a very conservative one. The crowded condition of the shelves in various parts of the Library impedes progress and demands that constantly more and more time be given to shifting the books on the shelves in order to get a little more free space at different points. If additional space is not provided for the Library in another year, the growth and work of the Library will be seriously handicapped. In the meantime we are encouraged to overlook the many inconveniences of the present crowded quarters by dwelling hopefully on the prospects of adequate and convenient quarters especially adapted for the Library to be provided in the new administration building. This will mean much to the Library, for at no time in the forty-one years of its existence has the Library been housed in quarters adapted for library purposes, nor has the dignity of its appearance been commensurate with the value of its collections. With ample room suited to its various requirements, the usefulness of the Library would be greatly increased.

ACCESSIONS.

The number of books and pamphlets added to the Library during the year amounted to 4,300. The total recorded number of books and pamphlets in the Library on July 1, 1909, was 104,300. During the year a special effort was made to complete imperfect files of periodicals. Among the sets completed may be mentioned the following:

American short-horn herd book; Bee keepers' review; Bulletin de l'Institut international de statistique; Entomologische zeitschrift; Gardening, London; Jahrbuch der chemie; Jahrbuch der electro-chemie; Jahresbericht über die fortschritte der chemie und verwandte theile anderer wissenschaften; Journal für praktische chemie; Linnean Society of London, Journal, botany; Mitteilungen aus dem forstlichen versuchswesen Oesterreich; Monthly microscopical journal; Münderer forstliche hefte; Munich, Königl. Bayer. akademie der wissenschaften zu München, Sitzungsberichte der mathematisch-physikalischen classe; Österreichische vierteljahresschrift für forstwesen; Receuil des travaux chimiques des Pays-Bas; Schweizerische entomologische gesellschaft, Mittheilungen; Societas entomologica rossica, Horae; Vierteljahresschrift über die fortschritte * * * der nahrungs- und genussmittel; Zeitschrift des Vereins für die rübenzuckerindustrie; Zeitschrift für electrochemie.

Among the important reference works added to the Library, the following are worthy of note:

Bouchard, Traité de pathologie générale; Diccionario enciclopédico Hispano-Americano de literatura, ciencias y artes; Digest of the Supreme Court reports; Eliot, Climatological atlas of India; Friedländer, Fortschritte der teerfarbenfabrikation; Hasse, A. R., Index of economic material in documents of the States of the United States, California, Massachusetts; Kayser's Vollständiges Bücher lexikon; Nelson's encyclopædia; Richet, Dictionnaire de physiologie; Sloane, Hans, Voyage to the islands of Madiera and Jamaica, with the natural history, etc.; Standard cyclopedia of modern agriculture; Wildeman, E. de, Icones selectæ horti thenensis; Wildeman, E. de, Plantæ novæ vel minus cognitæ.

It is regretted that the limited space for this report makes it impossible to give a record of all the government departments, societies, institutions, and individuals that have favored the Library with publications. There is not a State in the Union and scarcely any foreign government from which many publications of interest and value have not been received. Many of them probably are contained in no other library in the United States.

CATALOGUES.

The total number of cards added to the main catalogue during the year was 17,611, a decrease of 411 in comparison with the number added last year, which is explained by the fact that the catalogue section was hampered by the necessity of employing temporary assistants during a part of the year. The main (dictionary) catalogue now occupies five 60-drawer cases, and contains approximately 220,000 cards. The increase in the catalogue during the past year was due to the addition of the following cards: (1) Cards for the current accessions, (2) index cards for the publications of the Department, (3) index cards for foreign agricultural periodicals, (4) cards published by the American Library Association indexing scientific serials, (5) cards published by the New York Botanical Garden for current botanical literature, (6) Library of Congress cards for books of interest to the Department contained in the Library of Congress, the Geological Survey, and the Bureau of Education. In addition, some progress was made during the year in cataloguing the old books not previously catalogued, particularly in the classes relating to natural history, which are now completely catalogued.

The number of titles prepared for the Library of Congress by this Library during the year was as follows: (1) Cards for accessions, 959; (2) cards for current Department publications, 338; (3) reprinted cards for Department publications, 711; (4) cards for three foreign agricultural periodicals, 60; total, 2,068, an increase of 782 over the number of titles printed last year.

The printing of our catalogue cards by the Library of Congress was begun in 1902, this Library being the first of the Department libraries to cooperate in this way with the Library of Congress. The number of titles prepared since 1902 stands as follows:

December, 1902, to June, 1903	1, 059
July, 1903, to June, 1904	880
July, 1904, to June, 1905	3, 961
July, 1905, to June, 1906	1, 568
July, 1906, to June, 1907	2, 584
July, 1907, to June, 1908	1, 286
July, 1908, to June, 1909	2, 068
Total	13, 406

Libraries possessing the books described on these cards can purchase cards from the Library of Congress at much less cost than they could be prepared by each library. They are also useful for bibliographical purposes. "Although neither the collection of the Library of Congress on agriculture nor that of the Department of Agriculture has been to any considerable extent recatalogued with printed cards, there are now in stock in the Library of Congress, in addition to about 2,500 cards for publications of the United States Department of Agriculture, about 10,000 printed cards on agriculture comprising: (a) Cards for copyrighted books received by the Library of Congress since 1898; (b) cards for accessions by purchase, gift, or exchange which have come to the Library of Congress since 1901 and to the Library of the Department of Agriculture since 1902; (c) cards for recatalogued books on entomology (bulk of collection at both libraries being now covered); (d) cards for other books recatalogued at the Library of Congress, consisting chiefly of earlier editions of books recatalogued along with later editions currently received; (e) analytical cards issued for three important foreign agricultural periodicals."[a]

In order to make these cards as useful as possible the Library of Congress is preparing a traveling author catalogue which will contain one copy of each card in stock on agriculture, designed to be used in ordering cards by number. The use of this catalogue can be obtained from the Library of Congress by the payment of the transportation charges. In this connection the question arises whether it would not be worth while for agricultural libraries to purchase all the cards represented in the traveling catalogue. If a library can not afford this, it may perhaps be possible to purchase the proof sheets of cards on agriculture. "Although less satisfactory than cards for most uses, the proof sheets furnish a much less expensive record of the new books on agriculture received by the Library of Congress and the Library of the United States Department of Agriculture."[a]

CATALOGUE CARDS FOR DEPARTMENT PUBLICATIONS.

During the past year the Library has prepared cards for all the current publications of the Department, the number of titles being 338. In view of the fact that the supply of cards issued by this Library previous to 1906 is exhausted, it was decided during the past year to revise and reprint all of the cards, the revising to be done by this Library and the printing and distributing by the Library of Congress. The major part of the cards have now been reprinted and by January, 1910, it is expected that all of the publications of the Department for which it is practicable to issue printed cards will be available in the stock of cards at the Library of Congress. It is estimated that the complete dictionary catalogue set of cards will contain about 12,500 cards and will cost between $90 and $100. As some changes have necessarily been made in the author and subject headings in the course of the past ten years during which the cards have been printed, the Library of Congress has generously made provision for "verifying the files of cards now located in libraries and experiment stations by preparing a traveling catalogue showing the cards which should be in the set and the arrangement recommended by the Library of the Department of Agriculture." Libraries which possess a set of the cards in the small index size are, however, strongly advised to substitute for them a complete set of the cards in the large size.

INDEXING AGRICULTURAL LITERATURE.

In 1904 the Library, in cooperation with the Library of Congress, began the card index to three important foreign agricultural journals, namely: Annales de la science agronomique, Landwirtschaftliche Jahrbücher, and Die landwirtschaftlichen Versuchsstationen. The periodicals have been indexed from the beginning of each set and the index has been kept up to date from year to year. The cards are printed by the Library of Congress and are available for purchase, the cost of the three complete sets being between $50 and $60. The indexing of these periodicals on cards was begun in an effort to make available in the most accessible form the literature of scientific research in agriculture which is so largely embodied in periodical publications, and the intention was to extend the indexing as rapidly as funds would permit. The demand for the cards by libraries and scientists has not, however, encouraged this Library or the Library of Congress to assume the responsibility and expense of printing cards for additional periodicals. The Library has prepared during the past year analytical cards for the official publication of the Italian ministry of agriculture, industry, and commerce, entitled "Annali di Agricultura." In view of the importance of this series and the fact that each number is a contribution on some special subject, it was considered advisable to incur the expense of printing the cards for the set. The cards are now in press and will be available at the Library of Congress in a short time.

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[a] From Library of Congress, card section, Bulletin No. 14, ed. 2, which see for further particulars regarding cards on agriculture.

The project of printing a monthly cumulative index of the official agricultural journals of foreign countries has been under consideration for some time, but as yet no definite decision has been made in the matter. The majority of these journals are or should be contained in the libraries of the state agricultural colleges and experiment stations, and a complete index to their contents would without doubt be as useful to these libraries in this class of literature as the monthly cumulative indexes of literary periodicals are to the general libraries. If sufficient interest in the undertaking is expressed, the Library will make every effort to have the plan carried out. An index of this kind in book form would not be as expensive as an index on cards, and if published cumulatively would doubtless prove as satisfactory.

PERIODICALS.

The periodicals currently received during the year numbered 1,879 different titles, exclusive of annual reports of societies and institutions. Of this number, 669 were purchased and 1,210 received by gift and exchange. The number of new titles added during the year was 169. To meet the current demand it was necessary to subscribe for second copies of 34 periodicals, three copies of 8 periodicals, and four copies of 1 periodical. The periodicals of which more than one copy is required are all important and in most cases expensive. This duplication is always a source of great regret; but as long as the various Bureaus of the Department are so widely separated and at such a distance from the Library, there seems no satisfactory way to avoid the duplication. In a recent article President Hadley, of Yale, said:

> The university library must spend relatively large amounts of money on current periodicals as compared with books, because there, more than anywhere else, are exemplified the results and methods of current research.

This statement applies particularly to this Library, for it is especially true of scientific literature. The cost of caring for periodicals is much greater than the cost of caring for books. The circulation of periodicals, the maintenance of complete files, and the binding of files when completed all involve a great amount of labor, which adds much to the cost of the original subscriptions. When numbers are lost in circulation they are much more difficult to replace than books, and only too often are not obtainable at any price. Out of a staff of 20, the work of the periodical section requires the services of 4 assistants, who are often obliged to work overtime to keep the current work even approximately up to date. In no branch of the Library's work are the services of additional assistants so badly needed.

Of the 1,879 periodicals currently received, 1,213 circulate regularly among the various Bureaus, Divisions, and Offices. The number of Bureaus and Offices to which the periodicals are sent regularly varies from one to twenty. The circulation in a Bureau is attended to by the librarian of the Bureau, some periodicals being sent regularly to 24 individuals. After circulating in this way the numbers are returned to the Library and sent out again to another Bureau or Office for circulation in the same manner. During the months of April and May, 1909, a count was kept of the number of pieces received each day for new entry and the number of those returned from circulation either for filing in the Library or to be sent out again. The result of the count was as follows:

New numbers received and recorded in April (26 days)	4,475
New numbers received and recorded in May (25 days)	4,523
Total (51 days)	8,998
Daily average	176
Numbers returned from circulation in April (26 days)	6,260
Numbers returned from circulation in May (25 days)	4,731
Total (51 days)	10,991
Daily average	215
New numbers received and recorded, daily average	176
Average number of pieces handled daily	391

The regular circulation has increased greatly during the year, as has also the circulation of numbers requested for special reference. Of the 1,879 periodicals received, 456 are filed in the various Bureau libraries. Of the 1,433 filed in the Library, 691 are filed in pigeonholes in the periodical reading room until the volume is finished. It is regretted that the limited space available for the periodical reading room does not allow room enough for pigeonhole cases sufficient to accommodate the current files of all the periodicals, as much time is consumed in getting from the shelves the current numbers that are requested for special reference.

To meet the demand for information regarding the periodicals received by the Library a list of those currently received is being prepared. The list is to be arranged alphabetically by the title of the periodical, and is also to have a subject index. It is believed that this list will be of great assistance in showing the resources of the Library. The list printed in 1894 has long been out of print, and the number of periodicals currently received by the Library has more than doubled since that date.

BINDING.

The number of books and periodicals bound during the past year was 1,910, a decrease of 299 as compared with the previous year. The funds for binding are allotted to the Library from the general appropriation for the printing and binding of the Department and have never been sufficient to meet the needs of the Library. In addition to the 1,879 periodicals currently received, the Library receives not less than 2,500 other serials, such as annual reports and proceedings of institutions and societies, a very large part of which come in paper binding. If to the number of serials which annually require binding is added the large number of separate works which come only in paper form, and the number of volumes that each year need rebinding, no other argument will be needed to prove the insufficiency of the funds available for our binding when this total is compared with the number of volumes actually bound during the past few years. In a library of this size and character 5,000 volumes is a most conservative estimate of the number of volumes which should be bound each year. The arrears in binding have accumulated from year to year until now the possibility of bringing the binding up to date can only be attained by a special appropriation for the purpose or a greatly increased annual appropriation. In the meantime the preservation of the files of periodicals will be a difficult matter, and their usefulness in this unbound form will be greatly lessened. Furthermore, it is extremely difficult and expensive in time to keep the book shelves in neat and orderly condition when they are loaded with so much unbound material.

LIBRARY PUBLICATIONS.

The Library publications of the year include the four quarterly bulletins (Nos. 69–72) entitled "Accessions to the Department Library," comprising 283 pages, or an average of 70 pages to a bulletin. This record of accessions has now reached a size large enough to make it seem advisable to publish the list monthly instead of quarterly. The matter is now under consideration and it is probable that the publication of a monthly bulletin will be begun with the calendar year 1910. By publishing the list more frequently it is believed that its usefulness will be much increased.

USE OF THE LIBRARY.

During the past year the charges recorded at the loan desk numbered 30,606, an increase of 8.136 as compared with the previous year. The record of similar charges for the past five years is as follows:

Year.	Number.	Increase over preceding year.
1905	13,749	(*a*)
1906	18,136	4,387
1907	19,061	825
1908	22,470	3,409
1909	30,606	8,136

[a] No statistics of the circulation were kept previous to 1905.

The above figures show that the circulation has more than doubled during the past five years and that the increase in the circulation of the past year has nearly doubled the increase in any preceding year.

As explained in previous reports, the above statistics do not include a record of the circulation of single unbound numbers of periodicals, nor do they include a record of the daily use of books deposited in the libraries of the various Bureaus and Divisions of the Department. They also do not include a record of the books used in the Library, and therefore not charged at the loan desk. As free access to the shelves is allowed, it is impossible to keep any record of the use of the books in the Library. The statistics do, however, include the record of books borrowed from other libraries. In this connection it may be said that the increase in the circulation of the Library during the past few years, which is no doubt due largely to the growth of the Department, is also due in part to the increased use of the resources of other libraries. If a book is requested which is not contained in this Library, the effort to make it available, if it is important, does not stop here. Inquiry is next made at the Library of Congress, and if it can not be obtained from that Library it not infrequently happens that the search is continued in other libraries until the desired work is finally found. The record of the location of these important works is preserved and will in time be a valuable supplementary catalogue.

Beginning with February, 1909, a record was kept of the number of books borrowed from the Library of Congress and other libraries, and it was found that the average number borrowed each month from February to June was 339. To the libraries that have generously aided in this way the work of the Department our sincere thanks are due. We are especially indebted to the Library of Congress and the Library of the Surgeon-General's Office, on which libraries the most frequent demands have been made.

The number of books borrowed from this Library during the past year by scientists outside of the city was 416, an increase of 35 as compared with the previous year. The circulation by States, etc., was as follows: Arizona, 13; California, 1; Colorado, 7; Connecticut, 10; Florida, 81; Georgia, 1; Hawaii, 14; Illinois, 11; Indiana, 2; Iowa, 2; Kansas, 1; Louisiana, 12; Maine, 17; Maryland, 12; Massachusetts, 3; Michigan, 7; Minnesota, 9; Mississippi, 2; Missouri, 4; Montana, 1; Nebraska, 12; New Hampshire, 3; New Jersey, 3; New York, 53; North Carolina, 18; Ohio, 17; Oregon, 1; Pennsylvania, 33; Porto Rico, 2; South Carolina, 3; Tennessee, 3; Texas, 1; Vermont, 16; Virginia, 28; Washington, 1; Wisconsin, 9; Wyoming, 1; Canada, 1; Jamaica, 1.

By far the greater proportion of the books were sent to scientists connected with the various agricultural colleges and experiment stations.

MAILING LISTS AND FOREIGN EXCHANGES.

It has been some time since a report has been given in regard to the various mailing lists in charge of the Library, therefore it seems advisable to present a somewhat detailed statement at this time. As it was found desirable to have in one place the information in regard to the various foreign mailing lists of the Department, the lists were placed in charge of the Library about thirteen years ago. This arrangement has been the means of preventing duplication in the sending of publications and has been an advantage to the Library in obtaining exchanges. In addition to having on file in the Library the foreign mailing lists of the Bureaus and Divisions, the Library has direct charge of (1) the "Libraries list" (a list of libraries and institutions in this country and abroad to which are sent all the publications of the Department), (2) the Library Bulletin list, (3) the foreign mailing list of the Yearbook, and (4) the foreign mailing list for the Farmers' Bulletins. The "Libraries list," the Library Bulletin list, the "Yearbook" list, and the "Farmers' Bulletin" list are the only lists over which the Library exercises control (guided by the directions contained in departmental order No. 96), but it is fortunate in having the cooperation of several of the Bureaus in arranging exchanges. The extent of the various lists filed in the Library is given below:

	United States.	Canada, Mexico, and Cuba.	Foreign.
Bureau of Animal Industry	....	41	300
Bureau of Biological Survey	....	(a)	226
Bureau of Chemistry	....	42	184
Foreign trade journals	....	....	66
Bureau of Entomology	....	25	195
Bureau of Plant Industry	....	13	75
Bureau of Soils	....	43	175
Bureau of Statistics	....	37	139
Bureau of Statistics, Crop Reporter	....	....	212
Forest Service	....	44	206
Office of Experiment Stations:			
Education	....	8	14
Experiment Station Record	....	97	765
Farmers' Bulletin	....	23	....
Irrigation	....	40	88
Nutrition	....	12	164
Office of Public Roads	....	....	25
Libraries	158	6	46
Library Bulletin	250	....	....
Farmers' Bulletin	46	12	66
Yearbook	....	....	235

[a] List not filed in Library.

It is difficult to say definitely whether the publications received from foreign countries equal in amount the number of publications sent, but it is certain that the number of publications received is very large and that the publications themselves form a most valuable part of the Library. In the distribution of the publications the objects have been, first, to place them where they will be of service; second, to obtain exchanges when possible and desirable. In endeavoring to obtain exchanges, the aim has not been to amass in the Library as much material as possible, but rather to make available for the investigations of the Department the results of similar investigations in foreign countries.

BUREAU AND DIVISION LIBRARIES.

About one-third of the books belonging to the Library are deposited in the libraries connected with the Bureaus and Divisions. The approximate number in each collection (exclusive of United States Government and State publications, which are duplicates of files in the main Library) is given below:

	Books.	Pamphlets.		Books.	Pamphlets.
Bureau of Biological Survey	3,500	5,000	Dairy Division	800	1,200
Bureau of Chemistry	2,570	220	Office of Experiment Stations	1,000	....
Bureau of Entomology	4,500	6,500	Office of Public Roads	500	300
Bureau of Plant Industry	3,330	3,800			
Bureau of Statistics	5,400	1,800	Total	24,100	23,320
Forest Service	2,500	4,500	Weather Bureau[a]	23,350	6,000

[a] The books contained in the Weather Bureau Library have not been included in the record of books contained in the Library of the Department.

The Bureau of Animal Industry and the Bureau of Soils, which are in the same building with the Library, have no separate bureau collections. All books for the use of the Department in Washington are purchased by the main Library, and, with the exception of the Weather Bureau, all books purchased are recorded in the catalogue of the main Library. Through the cooperation of the Bureaus, the Library also receives a record of a large part of the gifts and exchanges sent direct to the various Bureaus.

The extent of the various collections has been largely governed by circumstances in which the distance of the Bureau from the main Library and the crowded condition of the shelves of the main Library have been important factors. Some of the collections comprise nearly all the books in the Library on the subjects of special interest to the Bureau, others are limited strictly to a working collection, while still others are not complete and yet are not selective enough to be considered working collections. In some of the libraries the books are classified on the shelves in the same way in which the books in the main Library are classified, while in other Bureau libraries the books are arranged on the shelves in accordance with schemes devised by the Bureaus, though the classification numbers of the main Library are not changed. With the growth of the Library and the special collections the time is not far distant when a settled and definite policy should be adopted in regard to the relation of the one to the other.

The problem of special libraries is one which has occupied the attention of many librarians, and in view of the importance of the problem it seems advisable to give here, in this connection, the arguments and conclusions of the librarian of one of the largest universities in the United States, a university where much research work is done. If the word "bureau" is substituted for the word "department" in the following statement, the arguments seem to apply very well to our own problem:

> The arguments in * * * favor [of special libraries] are: (1) More convenient use of the books by the workers in the department concerned, because the collections, being comparatively small, can be more easily handled and can generally be installed in such a way that more table space in close proximity is available; (2) in the case of scientific subjects, the possibility

of having the books in or near the laboratory, which is the natural headquarters for scientific work. The arguments against such a policy are: (1) Increased difficulty of access for persons not immediately connected with the department, the result either of want of familiarity with the arrangement and the rules of the special library, or of its being open less constantly or lending its books less freely than the central library; (2) less careful supervision of the library, or else increased expense for its administration, and in most cases less security from fire; (3) the loss of the reenforcement which each department of a general library receives from all related departments, unless the special library at considerable extra expense goes outside its own special field and acquires works which also belong in other departments and must be duplicated there (the publications of learned societies and many other important periodicals of too general a nature to be included in a department library have, of course, to be left in the central library); (4) a tendency to narrowness which the student who works in a well-equipped comprehensive library is likely to escape; (5) the growth of the special collection beyond a convenient size, while its earlier treatises and old editions become superseded by new ones, the natural result of which is that the central library is asked to take back the less useful books with which the special library no longer wants to be cumbered. These various considerations have more or less weight in different cases, according to the subject, according to the situation and size of the library, and according to the habits and traditions which have prevailed in the college; but they make it fairly clear, as it seems to me, that in general the ideal arrangement is to have a strong and comprehensive central library, with commodious and conveniently situated study rooms for professors and advanced students, supplemented by well-selected working libraries in the departments * * *. In the case of the department libraries * * * it seems to be impracticable to make complete collections in the subject concerned in either one place or the other; but the disadvantages of separation can be diminished by keeping a record in the central library of what the department library has, by transferring to the department everything in certain restricted technical lines, by encouraging it to transfer to the central library whatever it may receive by gift or exchange that is of a more general nature than the specialty that it naturally cultivates, and by providing in the general library as ample conveniences as possible for study, so that the books can be readily used in connection with those in other related fields. If, in addition to this, the books in the department library are classified on the shelves in the same way in which the books in the central library are classified, their use will be still further facilitated. There remains to be considered the relation of the various laboratory * * * libraries to the main library. * * * Such collections should, in my opinion, be restricted in size, the less used and the out-of-date books being weeded out from time to time and sent to the college library, while other books, if of a distinctly technical character and not likely to be wanted by other students, can be taken from the college library and deposited in the laboratory for as long a time as they are needed. Books much used, however, unless simply laboratory manuals, should undoubtedly be provided in duplicate and be accessible in both collections.

When permanent quarters are provided for the Library in the new administration building it is hoped that the space at the disposal of the Library will be ample to enable it to carry out the "ideal arrangement" as outlined above.

COOPERATION WITH THE LIBRARY OF CONGRESS.

We are not infrequently asked whether the Department of Agriculture Library is a part of the Library of Congress. Our answer is that there is no official connection, but that we endeavor to cooperate with the Library of Congress in every way possible. In this cooperation our Library has been immeasurably benefited. In discussing in his last report the relation of the Library of Congress with the other Government libraries of the District, the Librarian of Congress calls attention to the opportunities for service which the Library of Congress offers to the Department libraries, and suggests that its opportunities "should not merely affect its relation with the other Government libraries in the District, but tend to modify their own collections and aims." His definite suggestions are as follows:

> (1) That they should now limit their collections to their respective special fields; that they should eliminate accumulated material outside of these fields, and that they should hereafter acquire and maintain no book that will be sufficiently available if procurable from the Library of Congress within a half day of the demand.
>
> (2) That they should secure prompt and explicit information as to what material exists in the Library of Congress of possible interest to the work of their Bureau, and should in turn supply to that Library similar information as to the contents of their own collections.
>
> (3) That they should recommend to the Library of Congress the acquisition of material (even very special in character) fundamental in their work, but beyond their means.
>
> (4) That, so far as practicable, they should utilize the administrative work of the Library of Congress by conforming their own systems of classification, of cataloguing, and of notation to those adopted by it. In this way alone can they take full benefit of its printed cards, or through its printing office, give to it and to other institutions the benefit of their own.

With the above suggestions the policies of this Library are heartily in accord. For several years the purchases of this Library have been limited to the subjects of special interest in connection with the work of the Department and old material of little or no interest is being weeded out as rapidly as possible. We have incorporated in our general catalogue the Library of Congress printed cards for books in the Library of Congress and other governmental libraries of interest in the investigations of the Department, thus making known as far as possible the library resources of the city along lines of interest to the Department. We have suggested to the Library of Congress the purchase of expensive works on subjects connected with the work of the Department, but not needed for frequent reference, which it is most desirable to have available in the city. We have adopted the Library of Congress catalogue rules and have made use of its printing office for the printing of cards for our accessions, etc. We have not, however, been able to conform to the Library of Congress system of classification, since so large a part of this Library was catalogued previous to the adoption by the Library of Congress of its present classification, and we have not had sufficient assistance to attempt a reclassification. This is regretted, as our Library has in many classes outgrown its own broad classification and it would without doubt be benefited by the adoption of the classification of the Library of Congress.

In addition to enjoying the advantages due to the cooperation outlined above, the Library has been benefited especially by the very generous policy of the Library of Congress in lending its books for official use. It daily delivers at this Department, without any expense to us, the numerous books which we request for use in the research work of the Department.

RELATION OF THE LIBRARY TO OTHER AGRICULTURAL LIBRARIES.

It has been the aim of this Library to help bring about a greater cooperation between agricultural libraries. A closer relationship and better understanding of each other's needs would no doubt result in mutual benefit. The collections of this Library, which in agriculture and the allied subjects are the largest of any agricultural library in the country, contain many periodicals and works too expensive for each agricultural college to purchase, and it has been the policy of the Library to place these works at the disposal of the various agricultural colleges and experiment stations as freely as possible without interfering with the work of the Department, for it is felt that agricultural investigators throughout the country have a just claim on this the national library of agriculture. This Library has likewise been the recipient of similar favors from other libraries. The benefits of such cooperation are most readily seen and the practice of mutual lending between libraries is growing from year to year.

The printed catalogue and index cards described in detail in another part of this report have also been an effective means of cooperation by making known the resources of this Library. Agricultural libraries should not be behind the public libraries in making full use of these cards. The cards for Department publications, it is feared, have not always been cared for by the agricultural colleges and experiment stations, for whose benefit they were especially intended. They have in some cases never been removed from their original wrapping. This has been discouraging, but, needless to say, this has not occurred in the well-organized agricultural library.

The Library has in the past few years received several requests for advice and assistance in the organization and reorganization of agricultural libraries, which it has always been glad to give in so far as possible. Assistance of this kind has been considered a part of the legitimate work of the Library. Several librarians from agricultural colleges have at various times spent from one to three months with us for the purpose of studying the Library's collections and methods.

As a means of bringing about a closer cooperation between agricultural libraries and as a means to further their advancement there has been under consideration a plan for a meeting of librarians of agricultural libraries which it is believed would stimulate interest and be productive of good results. Among the subjects and problems which might well be considered with profit are the following: Classification of agricultural libraries; reference books of special interest to agricultural libraries; the arrangement of the publications of the Department of Agriculture and the publications of the State experiment stations; printed catalogue and index cards; the most important foreign agricultural and scientific periodicals for an agricultural library; cooperation in purchase; union lists of agricultural periodicals contained in agricultural libraries; duplicates and their exchange; instruction of students of agriculture in the use of the library; relation of the agricultural college library to the experiment station library; relation of the United States Department of Agriculture Library to other agricultural libraries. There are many other problems which might be discussed with profit, but enough have been given to indicate the advantages to be gained by cooperation of this kind.

RECOMMENDATIONS.

In conclusion, the most pressing needs of the Library may be briefly summarized as follows: (1) Additional assistants for the periodical section; (2) an appropriation for binding commensurate with the Library's needs; (3) an increased appropriation for the general expenses of the Library, sufficient to enable the Library to keep pace with the growth and demands of the Department and in addition to extend its services to other agricultural institutions by lending from its collections, by giving assistance in the organization and reorganization of their libraries, and by furnishing indexes and bibliographical information relating to agriculture and the related sciences; (4) convenient and commodious quarters adapted to the various requirements of the Library.

REPORT OF THE DIRECTOR OF THE OFFICE OF EXPERIMENT STATIONS.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., October 16, 1909.

Sir: I have the honor to present herewith the report of the Office of Experiment Stations for the fiscal year ended June 30, 1909.

Respectfully,

A. C. True, *Director.*

Hon. James Wilson,
Secretary of Agriculture.

INTRODUCTION.

As in previous years, the work of the Office of Experiment Stations during the last year has included the supervision of the expenditures of federal funds by the agricultural experiment stations in the several States; conferences and correspondence with station officers regarding the management, equipment, and work of the stations; the collection and dissemination of information regarding the progress of agricultural education and research throughout the world by means of technical and popular bulletins; the management of the agricultural experiment stations in Alaska, Hawaii, Porto Rico, and Guam; the promotion of the interests of agricultural colleges and schools and farmers' institutes throughout the United States; special investigations on irrigation and drainage, conducted largely in cooperation with experiment stations, educational institutions, and other agencies in different States and Territories; and the investigation of problems relating to the food and nutrition of man.

RELATIONS WITH AGRICULTURAL EXPERIMENT STATIONS.

Much attention has necessarily been given by this Office during the past year to questions growing out of the rapid increase of demonstration work and other extension enterprises carried on by the agricultural colleges and experiment stations. This has brought with it new problems relating to the organization of the work and the relation of the station force and funds to these enterprises. It is by no means a simple matter to draw the line in all cases between demonstration and experimental work or to determine what publications should be issued by the extension departments as distinguished from the stations. The fact that the stations have the franking privilege, while the extension departments do not, has easily led to the inclusion in the list of station publications of many which are not in any true sense reports of experimental work.

Greater confusion has been produced from the fact that legislatures granting funds for extension work have in many instances so worded the appropriation acts as to put the money under the control of the stations. This has led to a feeling in some quarters that such work is appropriate for the stations and that they ought to retain and develop it. The federal funds given to the stations are very apt to become involved in extension work when it is done under such circumstances. The services of station officers paid from the federal funds are often desired for extension work. Printing of what are really extension documents may be paid for from the Hatch fund, and miscellaneous expenses laid upon these funds which would not have been incurred but for the pressure for extension work. It has therefore been necessary to make a closer scrutiny of the station accounts with reference to this matter, and to insist that full provision be made to charge all extension expenses to other funds. The Office has also urged that as rapidly as possible a definite and separate organization be provided for the extension service and adequate funds be obtained to maintain this service without encroaching on either the station or the regular college work or funds.

The public and their representatives in legislatures and administration offices do not yet fully understand the magnitude of the enterprise involved in bringing home to the millions of men and women on the farms the results of the work of scientists and practical men for the improvement of agriculture and the general conditions of country life. The officers now employed in the agricultural colleges and experiment stations can not do this work in any large way. It is true that they have in the past done much to show the desirability of extension work in agriculture and to develop the lines for such work. But now that the movement is under way they are overwhelmed if they attempt to carry it.

Experimental work is also growing apace and should be pushed to meet the demand for new information arising on every hand. College students in agriculture are far more numerous than formerly and must be taken care of. The station and college men have more than enough to do in experimenting and regular teaching. If the people want the extension work properly done without injury to the colleges and stations, they must provide the funds wherewith to equip and man the extension departments and meet their expenses for printing, traveling, and other legitimate purposes. It should be clearly understood that the federal funds granted to the agricultural experiment station can not legally or wisely be used for the maintenance of extension enterprises.

As work under the Adams Act has developed it has become necessary for this Office to insist more strongly on the clear definition of projects and their limitation to subjects of reasonable scope. Unless this is done the temptation to scatter effort and merely accumulate data in a miscellaneous way without definite result is likely to prove too strong for many men. The operation of this act has brought into the service of the stations a considerable number of thoroughly trained men whose work has a definite aim and purpose. But the supply of such men qualified to work in agricultural lines is still too limited. Boards of control and executive officers have not yet sufficiently understood the requirements of research work so as to be willing in all cases to call in competent investigators when such men are not already on the station force. It is still too much the practice to divide the research funds among too many workers and thus permit too many men whose training and experience does not fit them for good research work to participate in it.

The need of a better system of publication of station work is growing more urgent. The present mixture of scientific and popular material, compilations, inspection tests, and analyses becomes more and more confusing and unsatisfactory to farmers and scientists alike. It is hoped that as the extension departments are organized they will take from the stations the great burden of compiling bulletins and miscellaneous routine correspondence.

A way should also be found to publish separately the detailed records and results of the scientific work of the stations. In many places valuable data are being accumulated and stored up because no feasible method of publication has been found. The practice is rapidly growing of publishing brief accounts of the scientific work of the stations in a great variety of scientific journals at home and abroad. As one means of disseminating information regarding such work such publication is a good thing. It can not, however, take the place of a full publication of the scientific work of the stations.

Such scrappy and scattered publication gives a very inadequate record of what the stations are doing in advancing knowledge and produces very little impression of the real services of the stations as public scientific institutions. The whole tendency of such a system is to build up the scientific reputation of the individual officer at the expense of the institution which he serves. A method of publication is needed which will bring together the scientific work of the American stations so that the world may know what these institutions endowed with federal and state funds are really doing to advance the science of agriculture. We actually have a great national system of research along agricultural lines, but at present this is almost wholly obscured by the confused and inadequate method of publication of the scientific work of the stations. The need of a better system grows more urgent with every year's advance of research under the Adams Act. It is therefore earnestly hoped that this matter will receive serious consideration at an early day and that active measures will be undertaken to remedy this glaring defect in our system of scientific inquiry on behalf of agriculture.

The work which is being done by the experiment stations abroad is not only of general interest to similar workers in this country, but much of it is applicable to our conditions, either directly or with modification. Through its relations with the foreign stations the Office is in position to follow this work with increasing completeness and to keep informed upon the progress of other matters relating to these institutions. A quite large number of periodicals and documents describing their investigations are now received in exchange for Experiment Station Record, and this has enabled the Office to become a clearing-house for the foreign work as well as that of our own stations.

RELATIONS WITH INSTITUTIONS FOR AGRICULTURAL EDUCATION.

The educational work of the Office of Experiment Stations for 1908–9 was continued under the same general arrangement as in the preceding year, but with an increase of $5,000 in available funds, one section dealing with agricultural colleges and schools and the other with farmers' institutes and other forms of extension work in agriculture.

THE AGRICULTURAL COLLEGES AND SCHOOLS.

The work of the Office relating to agricultural colleges and schools included, as formerly, four general classes: (1) The collection and publication of information regarding the progress of agricultural education at home and abroad; (2) studies of different grades of American and foreign schools in which agriculture is taught; (3) cooperation with the Association of American Agricultural Colleges and Experiment Stations and other important educational associations; and (4) aiding agricultural colleges and schools and state and local school authorities along lines of agricultural education. This work is in charge of Mr. D. J. Crosby, as specialist in agricultural education.

(1) The department of agricultural education in the Experiment Station Record has contained numerous abstracts and notes and occasional editorials relating to this subject. The preparation of these involved the examination regularly of many educational journals and other publications, both American and foreign. The foreign publications, more than 1,500 in number, were reviewed by Miss M. T. Spethmann, who has also reviewed about 1,000 American publications and has charge of the preparation of the annual statistics and the list of institutions in the United States offering courses in agriculture. There have also been published a circular on The American System of Agricultural Education and a bulletin entitled School Gardening and Nature Study in English Rural Schools and in London. A review of progress in agricultural education in 1908 was submitted for publication, as were also a circular on Education for Country Life and a bulletin on Secondary Agricultural Education in Alabama.

(2) Studies of American and foreign schools in which agriculture is taught have been carried on in connection with the editorial and other work of the Office, and the number of cards in the index to these institutions has been increased by 625, making a total of 5,800 such cards. The number of cards of foreign agricultural research institutions is now 1,390. In connection with the annual inspection of agricultural experiment stations and on occasions when members of the staff have been called upon to attend important meetings in the different States, the work of American colleges and schools of agriculture and of normal schools offering courses in agriculture has been studied. A special study of methods and equipment used in teaching agriculture in the land-grant schools for negroes in Alabama, Florida, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee was made for this Office by J. O. Rankin, professor of agriculture in Talladega College, Talladega, Ala.

(3) The educational work in cooperation with the Association of American Agricultural Colleges and Experiment Stations has been

carried on as formerly. The Director of this Office has continued to act as bibliographer of the association and as chairman of the committee of the association on instruction in agriculture, which submitted at the convention of the association in 1908 a course in agricultural engineering and is now engaged in studying courses in home economics, animal husbandry for public schools, and courses in agriculture in state normal schools. These courses have been prepared by specialists employed by this Office or by the committee, and if adopted will be published by this Office. The Director also acted as chairman of a committee of the association on the history of agricultural education and as dean of the third session of the Graduate School of Agriculture, held during July, 1908, at Cornell University. He has accepted the deanship of the fourth session of this school, to be held at Ames, Iowa, in 1910.

The specialist in agricultural education has continued to act as secretary of the committee on instruction in agriculture of the Association of American Agricultural Colleges and Experiment Stations, and in this capacity has directed the preparation of the manuscript courses in animal husbandry and normal school agriculture mentioned above.

(4) The facilities of the Office for aiding agricultural colleges and schools and state and local school authorities along lines of agricultural education have been improved and the demands upon the Office for work of this character have been greater than ever before. The perfecting of card indexes of agricultural colleges and schools and agricultural research institutions has facilitated the compilation of data frequently called for by correspondents concerning courses of study, appropriations, equipment, and foreign institutions.

The card directory of teachers and investigators in agriculture has been revised and extended until it now includes about 1,800 names. This directory is in charge of Miss M. A. Agnew, who has also recorded changes in the organization of agricultural colleges and experiment stations in the United States and compiled the annual bulletin entitled Organization Lists of the Agricultural Colleges and Experiment Stations in the United States.

Requests for assistance in outlining and organizing agricultural courses and for other information along these lines are steadily increasing in number. About 3,000 such requests were attended to during the past year and in many cases the replies involved the compilation of considerable data not available in published form. Requests for public addresses, conferences, and other services involving travel by members of the Office staff have been far in excess of our ability to grant. The specialist in agricultural education was in the field on such work over three and one-half months and his assistants two months.

Mr. H. O. Sampson, after returning from furlough June 1, 1908, and spending the months of June and July in summer schools for teachers, resigned to accept a higher salaried position. He was succeeded in February, 1909, by Mr. F. W. Howe, instructor in agriculture in the Michigan Agricultural College, whose special fitness for the educational work of this Office was acquired not only through the study of agriculture, but also through long experience as a teacher and an administrative officer in different types of schools and colleges.

Mr. Howe has assisted in the general work of the agricultural education service, lectured at a number of summer schools and conferences, and organized boys' corn clubs in Michigan with a total membership of about 1,700.

Plans for 1909-10.

In connection with the work of promoting boys' agricultural clubs in different parts of the country, tentative plans have been made to cooperate with the agricultural explorer in charge of foreign seed and plant introduction of the Bureau of Plant Industry to send certain foreign introductions to the boys for testing, and thus get them interested not only in competitive crop growing, but also in the work being done by this Department to introduce new agricultural plants. With this exception the plans for next year do not differ materially from those of the year covered by this report.

FARMERS' INSTITUTES AND EXTENSION WORK.

The rapid development of farmers' institutes has demonstrated in an unmistakable way the great demand that exists for this kind of extension work. Six years ago, when an appropriation was made to this Department to enable it to appoint a special officer to investigate and report upon farmers' institutes and similar organizations, institutes were held in forty States and three Territories to the number of 2,772. In forty of these States and Territories the approximate attendance was reported at 820,000. In the past year, 1909, all of the States and Territories have institute organizations, and there were held 4,926 regular institutes, consisting of 15,210 half-day sessions, with an attendance of 2,196,568. For the maintenance of these institutes over $338,000 was appropriated. There have been also independent and round-up institutes, railroad specials, and other forms of institute activity attended by 710,131 persons, making the total number present at all forms of institute meetings during the past year about 3,000,000, an increase of more than 260 per cent over the attendance of six years ago.

In aid of this movement the Office has published, since the inauguration of its institute work in 1902, 15 bulletins, 5 circulars, 6 statistical reports, and 10 syllabi of illustrated lectures relating to institute subjects, and its institute specialist has visited all of the States excepting three, some of them repeatedly, advising with institute directors, and addressing representative meetings composed of institute lecturers and managers. The work of the Office relating to institutes has extended until it has been found necessary to secure an assistant to the institute specialist. Dr. John M. Stedman, a professor in the University of Missouri, was appointed to this position and has been on duty since May of this year. Prof. John Hamilton continues in charge of the institute work of the Office.

Among the more marked developments along institute lines are the railroad specials, which are now conducted in most of the States. These specials are equipped with illustrative material and provided with a corps of lecturers who address audiences of farmers at the local stations on the lines of the road. One hundred and fifty-five thousand persons were reported in attendance upon these trains during the past year, and had opportunity to hear the lectures and examine the exhibits illustrating the practical value of the instruction given.

Normal institutes for the instruction of institute lecturers have become common, and are now regarded as necessary adjuncts of every well-organized institute system.

Movable schools, continuing from one to two weeks in a locality, seem destined to become leading features in future institute development. This Office has aided in this movement by preparing courses of study suitable for use by such schools, and by publishing a circular giving specific directions for their organization.

Institutes specially for women are rapidly being organized, and in all probability will soon equal in number of members and in effectiveness those established for men. In their development this Office has endeavored to assist through a circular calling attention to their importance. This circular also outlines methods by which such institutes may be organized and successfully conducted.

The Office has cooperated with the American Association of Farmers' Institute Workers through the publication and distribution of the proceedings of its annual meeting. The institute specialist of the Office has been acting as the secretary-treasurer of the association, and has had charge of arranging its programmes, selecting speakers, and editing the proceedings. The great advance made in the direction of unifying methods, and thereby strengthening the institute work of the country, is in large measure due to the efforts of this association. The Office has cooperated with the association and rendered such assistance as the means at its disposal have permitted.

For the past four years the Office has been cooperating with the standing committee of the Association of American Agricultural Colleges and Experiment Stations on extension work by assigning the institute specialist to act as secretary of the committee. The work of this committee has been very effective and was recognized by the association at its recent meeting in Portland by adopting at the suggestion of the committee a change in the constitution of the association, whereby a third section, to be known as the section on extension work, was created. The association therefore now consists of three sections—the college section, the experiment station section, and the section on extension work, thus recognizing extension work in education as coordinate with that of the college in its interior work, and the station in its work of investigation and research. This is a most important step in advance in agricultural education, and in securing its recognition this Office has to some extent shared. Agricultural extension now has, therefore, a recognized place in the educational system of instruction by the land-grant colleges and will undoubtedly offer a field for investigation along agricultural education lines that can properly be undertaken by this Office. The field is new and consequently undeveloped. There is need, therefore, for securing and disseminating information in this direction. The Office can materially aid this movement by organizing a clearing-house in agricultural educational extension, to which questions of administration and organization in extension work may be referred and where researches and demonstrations in agricultural education extension may be conducted.

Investigation for the development of agricultural education along extension lines is not only of extreme importance, but is urgent, and needs to be undertaken at once. To do this in a way commensurate with the importance of the subject will require larger means than are now at the disposal of this Office. Education extension in agriculture has suddenly come into such prominence as to demand much attention from those who have the needs of agriculture to provide for. This new movement requires that the interests of agricultural people shall be considered with reference to providing facilities for instruction in agriculture, not merely for the comparatively few students resident in colleges, but also for the great body of rural people who are unable to attend distant agricultural institutions or even to enter upon a normal or high school course.

PUBLICATIONS OF THE OFFICE.

The publications of the Office during the last year have been of the same general character as in previous years. The supervision of the editorial work of the Office, in case of all publications except the Experiment Station Record, is the special business of the editorial division of the Office, of which Mr. W. H. Beal is chief. The editorial management of the Record is in direct charge of Dr. E. W. Allen, Assistant Director.

During the fiscal year the Department published 57 documents prepared by this Office, not including revised reprints, separates, etc., aggregating 3,412 pages. These documents included 16 numbers of the Experiment Station Record, 14 technical bulletins, a bulletin of the Porto Rico Experiment Station, 2 reports of the Office, 6 Farmers' Bulletins (including 5 numbers of Experiment Station Work), 5 circulars, 12 monthly lists of experiment station publications, and a farmers' institute lecture. Two other numbers of the Experiment Station Record, 4 technical bulletins, 1 annual report of the Office, 3 Farmers' Bulletins, 1 article for the Yearbook of the Department, and several miscellaneous documents, containing about 1,150 pages, were prepared and submitted for publication before the close of the fiscal year. Thirteen separates of individual articles contained in larger reports, aggregating 463 pages, were reprinted in editions of varying size to supply requests for the articles.

Several of the earlier technical and Farmers' Bulletins prepared in this Office were exhausted during the year and were reprinted, with more or less important additions and corrections.

The publications of the Office during the year were, as heretofore, of five main classes: (1) Annual reports, including the administrative report of the Director and the larger annual report of the Office. (2) Experiment Station Record, which gives a technical review of the current literature of agricultural investigation throughout the world, and Experiment Station Work, which is published periodically in the Farmers' Bulletin series of the Department and gives a popular summary of some of the more salient practical results of the work of the experiment stations. (3) Publications relating to the food and nutrition of man, consisting of technical and popular bulletins, circulars, etc., reporting or based upon the results of nutrition investigations conducted under the auspices of the Office. (4)

Publications relating to irrigation and drainage, which include reports, technical and popular bulletins, circulars, etc., giving the results of the irrigation and drainage investigations of the Office. (5) Educational and other publications, including those relating to agricultural education in general, farmers' institutes, proceedings of the Association of American Agricultural Colleges and Experiment Stations, and of the Association of Farmers' Institute Workers, and similar publications, and the card index of experiment station literature, besides miscellaneous documents of various kinds.

ANNUAL REPORTS.

During the year the Office issued as usual two annual reports—one, the administrative report of the Director (of 29 pages), giving a summary of the work of the Office during the year for incorporation in the annual reports of the Department; and the other, the annual report of the Office (of 414 pages), specially authorized by joint resolution of Congress and containing the detailed reports of the results of the annual inspection of the work and expenditures of the state agricultural experiment stations, a summary of the work of the Office, and articles on nutrition, irrigation, drainage, farmers' institutes, agricultural education, and various special lines of investigation at the experiment stations, which are intended to show recent progress in agricultural research and education in the United States.

EXPERIMENT STATION RECORD.

During the year the twentieth volume of Experiment Station Record has been completed, together with the customary author and subject indexes to the volume. Abstracts of 5,332 articles have appeared in the volume. This is a far larger number than in any previous volume, and nearly 700 in excess of the number in Volume XIX. As in previous years, the abstracts have covered the publications of the agricultural experiment stations of the United States and the United States Department of Agriculture, the researches of experiment stations and similar institutions in all parts of the world, and a large number of articles having a direct bearing upon agricultural science and practice published in book form or in the journals of this country and abroad.

The number of articles to be covered in such a review has continued to increase, but the serious congestion of material awaiting publication, brought about by the space limitations discussed in previous reports, has been materially relieved by an arrangement whereby the regular monthly numbers are supplemented from time to time by additional issues known as abstract numbers. These numbers differ from the regular numbers in being made up almost entirely of abstracts, with only a small amount of space devoted to editorials and current notes. Two such numbers were prepared during the year, and it is thought that for the present one abstract number every three months, or four numbers per year, will be necessary to keep pace with the rapid increase in the number and importance of the articles to be reviewed.

In previous years the new volume has been begun with the September number, but on account of the inclusion of the abstract numbers it was deemed desirable to conclude Volume XX with the June number, thereby securing conformity with the fiscal year. Under the present plan there will be in the future two volumes per year, commencing, respectively, in July and January. This will reduce the individual numbers per volume from 12 to 8 for the present, which will make a smaller and less bulky volume for binding. An index number for each volume is planned.

As time goes on the value of the Record as a great repository of information pertaining to agriculture, otherwise available only by an extended examination of the enormous mass of literature which has been published, continues to increase. The 20 volumes thus far issued contain references to no fewer than 71,650 articles, besides editorials, special articles, and notes. The experiment station reports abstracted alone have numbered 868, the station bulletins and circulars 6,912, and the publications of this Department 3,055. The carefully prepared author and subject indexes to the individual volumes and a general index to Volumes I to XII have greatly enhanced the usefulness of the Record, and it is hoped to issue in the near future a general index to Volumes XIII to XX.

There have been several changes in the editorial staff. The place left vacant by the transfer of Dr. E. V. Wilcox to the Hawaii Experiment Station was filled by the appointment of Mr. W. A. Hooker, in charge of the editorial departments of economic zoology and entomology, and veterinary science. Mr. Hooker had been connected with the work of the Bureau of Entomology on the cotton boll weevil and the cattle tick. With the development of the work in human nutrition it became necessary to relieve Dr. C. F. Langworthy and Mr. R. D. Milner of their editorial work in animal nutrition and dairying. Mr. E. W. Morse, recently connected with the Bussey Institution at Harvard University, was placed in charge of these departments. Mr. G. A. Griffin, connected with the drainage investigations of the Office, has had charge of the abstracting in agricultural engineering. An increase in the editorial staff to enable certain important departments to be developed is planned. Dr. L. W. Fetzer, for several years assistant chemist at the Maryland Experiment Station, has been appointed to look after the literature relating to agricultural chemistry and technology; and an editor for bacteriology is being sought.

EXPERIMENT STATION WORK.

Five numbers of this series were issued during the year, first in large editions in the regular Farmers' Bulletin series of the Department, and afterwards in smaller editions (3,500 copies) with consecutive paging, so that they may be bound with index, table of contents, etc., in convenient form for reference.

CARD INDEX.

Copy for 1,000 cards of the index of experiment station literature was prepared in the Office and submitted for publication during the year. This keeps the index as nearly up to date as has been found practicable. Some of the earlier cards, of which the supply has been exhausted, have been reprinted in small editions in order to meet the increasing demand for sets and separate divisions of this index. The number of index cards distributed has reached 30,200. The receipts from sales of the index during the year were $369.92.

EXHIBIT AT THE ALASKA-YUKON-PACIFIC EXPOSITION.

This Office planned, prepared, and installed an exhibit illustrating its various lines of work at the Alaska-Yukon-Pacific Exposition at Seattle. Mr. J. I. Schulte had charge of this work. A large portion of this exhibit was devoted to the work carried on by the Alaska and Hawaii experiment stations. The material shown occupied 1 small and 6 large pavilion cases, in addition to a floor space of 144 square feet, covered by a model illustrating different methods of applying water in irrigation. An attendant was in charge of this exhibit during the entire exposition.

WORK FOR THE CIVIL SERVICE COMMISSION.

The Director of this Office has continued to act as the general representative of the Department in matters relating to the examinations held by the Civil Service Commission for technical and scientific positions in the Department. The number of papers received from the Civil Service Commission recorded in this Office and rated by examiners in the Department during the year was about 2,000, as compared with about 3,000 reported last year. Besides the regular examinations, 40 special examinations were held during the year, as compared with 46 last year.

INSULAR STATIONS.

A prosperous year is reported from each of the insular stations, and the work of all is developing as rapidly as the resources will allow. As a result of increased appropriations, new lines of work have been taken up by the Hawaii and Porto Rico stations, and in Alaska an effort is being put forth to develop the Fairbanks station on a sufficient scale to demonstrate the possibility of farming as an avocation in that country.

The conducting of investigations looking toward the diversification and improvement of agriculture continues to be the policy of the stations maintained by this Office. In countries where agriculture is as undeveloped or primitive as in Alaska, Porto Rico, and Guam, or where it is as specialized as in Hawaii, much attention must be given to pioneer and demonstration work in order that the results of scientific experiments may be brought to the people for whose interest the stations are striving. Experimental work is conducted to ascertain principles and to determine definite problems, and should never be forced for immediate results. However, when the application of the results of experiments at the stations will tend toward an improvement of agricultural practice, demonstrations are made not only on the station's ground but elsewhere, so as to give as wide publicity as possible to the new practices. That this policy has proved a wise one is shown by the changed conditions in every territory served by the insular stations. The suggestions of the Alaska stations regarding vegetable planting are being widely followed in that country.

The results of the experiments with rice, cotton, rubber, and fruit growing and shipment have been adopted in Hawaii, and improvements are evident in the methods of crop cultivation, use of fertilizers, and rotations, as well as horticultural practices and the improvement of live stock in Porto Rico. The work in Guam has been begun so recently that no results can be shown, but the people of that island are taking a lively interest in the station, and it is confidently believed that much good will result from its establishment.

On account of their isolation the stations often lack facilities for prosecuting special lines of investigations or do not obtain valuable accessions. As in the past, this want has been met by the generous cooperation of the several bureaus of this Department, and it is desired to make proper acknowledgment to them at this time.

The administrative work of the Washington office in connection with these stations continues to increase. This work remains in charge of Dr. Walter H. Evans. The duties of the accountant in connection with the fiscal affairs of the temporary disbursing officers have increased with the increase in appropriations, and the successful manner in which they are handled has been a cause of commendation. It has been found in many instances desirable to make purchases for the insular stations through this Office, and this requires considerable correspondence and attention. The matter of the publications of the stations has called for considerable time and consideration, as it has been the desire to have them all as accurate and attractive as possible. The ruling that the reports and bulletins of the Hawaii and Porto Rico stations should be published in those islands is not in the interest of the stations or of this Office. The work can be done better and more cheaply by this Department, and at a considerable saving of time, and it is recommended that Congress be asked to change the law so that while the privilege of printing emergency and other items in the islands is retained, the more formal reports and bulletins may be printed by this Department.

During the past fiscal year the revenue of each station was $26,000 as a direct appropriation, and this was supplemented by sales and other funds which were available for maintenance as follows: Alaska, $2,005.45; Hawaii, $355.89; and Porto Rico, $4,608.37.

It is gratifying to note the growing appreciation of the stations as shown by recent legislation. In Porto Rico $20,000 was appropriated by the insular legislature for an office and laboratory building, which is now completed and occupied, and in Hawaii the last legislature voted $10,000 for aiding in carrying on some of the lines of work now in progress.

ALASKA STATIONS.

But few changes were made in the personnel of the stations during the past fiscal year. Mr. Herman Zoellner was transferred from the Bureau of Plant Industry, of this Department, as propagator and gardener, with headquarters at Sitka, and Mr. Laurence Kelly was appointed assistant at the stock-breeding station at Kodiak. In consequence of the closing of the Copper Center station, Mr. C. W. Heideman was furloughed at his own request, and Mr. C. W. Heideman, jr., resigned.

The general policy of the Alaska stations as outlined in previous reports has been continued. The most important change has been in the temporary closing of the Copper Center station. This was decided upon for several reasons, among them its isolation, which made the transportation of supplies very expensive; insufficient rainfall, only 0.5 inch during April, May, and June of last year; early frosts, due to the proximity of high mountains; and the desire to develop the Fairbanks station, where conditions are believed to be more favorable, and where a larger population has already become established.

The station at Copper Center had been maintained for six years and about 40 acres of land brought under cultivation. Some success was attained in growing cereals, and crops of wheat, oats, and barley matured in favorable seasons. In other years nearly all the grains were lost, due to early frosts. The practicability of growing hardy vegetables in the Copper River Valley has been fully demonstrated. The rapid settling of the Tanana Valley seemed to call for more work in that region, and without additional appropriations it could only be done by closing one of the other stations. As a consequence a greater part of the implements and movable equipment was transferred to Fairbanks during the past winter, and the lands and buildings temporarily turned over to the Bureau of Education of the Department of the Interior. It is expected that some simple experimental work will be continued at Copper Center, and a report of the results given to this Office. The plant-breeding work begun at Copper Center, which had already resulted in the origination of some promising crossbred barleys, has been transferred to Fairbanks.

At Fairbanks the work was actively begun last year, and 60 acres cleared and brought under cultivation this season. A number of buildings have been erected, and a portion of the reservation is now fenced. A fairly good equipment of implements and tools has been provided this station and it is intended to prove or disprove the possibility of profitable farming in that portion of Alaska.

At the Rampart station there are 16 acres under cultivation, and it is planned to extend this area to about 24 acres this year. The past season at Rampart was favorable to all crops, and out of 65 varieties of grain seeded 57 matured their entire crop. All early varieties of oats and barley matured, but winter wheat and winter rye were partially killed on account of the snow drifting from portions of the field. This season's results are in line with those of the past eight years, and show that grain can be brought to maturity in the Yukon Valley without serious liability of failure.

Considerable progress is reported in the live-stock breeding station on the island of Kodiak. A herd of Galloway cattle wintered satisfactorily without any shelter other than that afforded by an open shed. During the summer the cattle grazed on the native grasses and during winter they were fed exclusively on hay and silage made from native grasses. Some difficulty has been experienced from an epidemic of contagious abortion, but it appears to have been checked. Several head of cattle died during the winter from impaction of the third stomach, although they were fed silage and hay in about equal quantities and were given all the water they could drink. The large range which has been chosen for the stock experiments has been fenced and some necessary buildings erected.

Horticultural investigations continue to be the chief lines of work at the Sitka station. Considerable attention is given to introductions, but the most promising investigations are along the lines of plant breeding. Mention has been made in previous reports of hybrid strawberries and crosses between the cultivated raspberry and the native salmon berry, in which wild plants were used as the staminate parents. These have begun bearing this season and the desirable forms will be selected for further observation. Other small fruits are propagated and distributed throughout the Territory as rapidly as possible. The experiments in attempting to find varieties of apples, cherries, and plums adapted to Alaskan conditions are being continued and considerably extended. Experiments with vegetables have been an important feature, and they have resulted in the elimination of many unsuitable varieties and the recognition of others which appear peculiarly adapted to the country.

The Alaska stations contributed extensively to the Alaska-Yukon-Pacific Exposition, creditable exhibits of cereals, grasses, fruits, vegetables, etc., being placed in the Office of Experiment Stations exhibit in the government building and also in the Alaskan building, where they were objects of much interest as illustrating the agricultural possibilities of the Territory.

HAWAII STATION.

During the fiscal year most of the lines of investigation already established were continued, and a number of new ones taken up. A few changes were made in the station staff. Walter P. Kelley, of the Indiana Experiment Station, was appointed chemist, D. L. Van Dine, for six years entomologist of the station, was transferred to the Bureau of Entomology of this Department, and D. T. Fullaway, formerly assistant entomologist, was promoted to the head of that department. Valentine Holt was appointed assistant in plant propagation.

In the department of agronomy particular attention has been given to forage crops, rice, and cotton. The experiments with forage plants have assumed great importance and are attracting the attention of ranchmen and planters who are learning the economic value of producing forage, especially from leguminous plants grown in crop rotations. The cultural and fertilizer work with rice is giving results of great value, and some of the better varieties of rice introduced by the station have been widely planted with gratifying results. The methods of fertilizing the rice crop devised at the station have resulted in more than doubling the yield of ordinary rice lands. Experiments with upland rice show that this crop can be depended upon for an excellent quality of grain hay, thus furnishing a much needed local supply of forage. Quite an unusual interest has been manifested in the growing of cotton, and investigations have been begun of some of the problems connected with the production of this crop. The station has a number of varieties representing Upland, Chinese, Egyptian, Sea Island, and Caravonica cottons under observation, and a number of promising strains have been developed. In propagating cotton, it has been found possible to grow it from cuttings, by grafting, etc. This is of especial value for the rapid production of desirable strains and the elimination of possibilities of cross fertilization.

All the varieties grow as perennials, but by systematic pruning it has been found possible to control the time of the maturity of the bolls. As the result of the station's work with cotton, about 100 acres were planted to this crop during the past year, and there is a prospect of more than 1,000 acres being planted next season. The preliminary experiments have given very satisfactory results, both as to yield and quality of lint.

The work with the Chinese and Japanese matting rushes has been continued, and a large number of plants are now available for distribution.

As a result of the horticulturist's investigations on the shipment of fruits, a large and growing business in shipping fresh fruits, especially pineapples, has been built up. Studies are being continued on methods of propagation of tropical fruits, such as citrus trees, avocados, mangoes, papayas, roselle, etc. Some improvements are noted in the methods of propagation of the mango, and good results have been obtained with an inverted T form of budding, the buds being cut 3 or 4 inches long. This method of budding can be followed when the stock is in flush and requires less time than some of the other methods. Studies are being made of the care of orchards, and for the eradication of scale insects and mealy bugs fumigation with hydrocyanic-acid gas has been demonstrated as preferable to spraying with insecticides. Plant breeding to secure better and more resistant varieties of horticultural crops forms an important part of the work of this department.

One of the most important lines of work taken up by the chemist has been a study of pineapple soils, particularly those on the island of Oahu, where pineapple plantings are being rapidly extended. These soils are of two types, red and black, the former being better adapted to the crop. A study showed that the black soils contained a high percentage of manganese, sometimes amounting to as much as 10 per cent. In the black soils the manganese is quite soluble and when absorbed by the plants causes them to turn yellow. It also accumulates in the form of manganese dioxid on the roots and root hairs and interferes with their absorptive powers. Fertilizer experiments have shown that the yellowing may be overcome, and it is hoped to work out a definite scheme for correcting the injurious conditions present in the black soils.

The entomological work has consisted in a study of cotton insects and the working out of methods for their control. A systematic study has been begun on the plant lice of the islands, and a number of new species have been found and many important facts regarding their life histories have been worked out. Arrangements have been made for cooperation with the Bureau of Entomology of this Department in the introduction of parasites of the algaroba bean weevil, plant lice, etc.

The algaroba beans are an important feeding stuff in Hawaii, but their full value was never obtained on account of their hard seeds. In cooperation with a skilled mechanic a method of grinding the beans has been devised and machines for this are now on the market.

The rubber experiments continue to receive considerable attention, and tapping experiments with 500 trees were conducted to determine some of the commercial aspects of this industry. It was demonstrated that the trees could be successfully tapped any time from

5 a. m. until noon; a sufficient flow of latex was secured to indicate that the cultivation of rubber trees would be reasonably profitable. Vertical cuts were found to give better results on Ceara rubber trees than any other form of tapping tried. Samples of rubber collected by the station were submitted to experts and were valued at from $1 to $1.30 per pound, with somewhat lower figures for the scrap and discolored samples. There are already 1,500 acres planted to rubber trees in Hawaii, and a new industry seems to be assured.

The Hawaii station cooperated actively in the preparation of material showing the resources of those islands at the Alaska-Yukon-Pacific Exposition.

PORTO RICO STATION.

Some changes were made during the past year in the personnel of the station. Mr. M. J. Iorns, horticulturist of the station for three years, died May 17, and he has been succeeded by Mr. C. F. Kinman, formerly assistant horticulturist at the Cuban Experiment Station, with Thomas B. McClelland as assistant. Mr. G. L. Fawcett, formerly connected with the Subtropical Laboratory of the Bureau of Plant Industry of this Department, was transferred to the Porto Rico station as plant pathologist, and Mr. William Hess, of the same laboratory, was transferred as expert gardener. Dr. William C. Taylor, of Harvard University, was appointed assistant chemist.

On account of the primitive condition of agriculture in Porto Rico much elemental work must be done by way of demonstration, etc. It is equally important that the efforts of the station be directed into lines of investigation relating especially to agriculture in the Tropics. For this purpose the station has been to a great extent reorganized and the work put under definite heads. The divisions as at present constituted are administrative and investigational, the latter being divided into departments of horticulture, plant physiology and pathology, chemistry, entomology, and animal industry.

The work of the horticultural department is largely that of plant breeding and acclimatization, and besides the very extensive work at the station cooperative experiments are carried on with representative planters in different sections of the island.

The work of the division of plant physiology and pathology has been largely confined to troubles of citrus fruits and pineapples, and, as far as time permitted, studies have been made of diseases of other fruits, sugar cane, and coffee. These investigations are carried on with the idea of determining the cause of the disease and methods of control.

The chemical work has been largely a study of soils. Tropical soils present problems totally distinct from those in temperate regions. The investigations now in progress principally relate to nitrogen, the activity of enzyms, and drainage waters. The practical side of these investigations looks toward the renovation of those soils that are worn out from continuous cropping, as in the case of the cane and coffee lands.

In entomology special studies are being made of the insects injurious to citrus fruits. The efficiency of sprays is being tested and certain modifications necessary under tropical conditions are being worked out. Experiments in combating the white grub of sugar cane have been carried on, and certain forms of chemical fertilizers have proved effective in destroying the larvæ of this insect, as well as increasing the yield of cane.

Efforts are being made to interest the people of Porto Rico in apiculture, and a number of hives have been already sold to planters in different sections of the island. While this industry will directly yield an added income, it will also assist materially in aiding in the pollenization of coffee during its short blossoming periods.

The live-stock equipment of the station has been increased by the purchase of a number of cattle and the importation of African woolless sheep. Considerable additions have been made to the poultry department, and the increase of all the animals is being disposed of by sale as rapidly as it is thought desirable. The demand for pigs, poultry, and eggs has been far in excess of the station's ability to supply.

A silo was constructed for the purpose of testing the advisability of storing certain crops when they are plentiful, with a view of feeding during the dry season, and the experiments with Para grass and cane tops have indicated the possibility of their utilization.

The material condition of the station has been greatly improved by the building of barns, poultry runs, and fences. The office and laboratory building provided by the insular government has been completed and the station for the first time is now adequately housed.

GUAM STATION.

The appropriation of $5,000 for the establishment and maintenance of an agricultural experiment station on the island of Guam became available at the beginning of the fiscal year. As stated in the previous annual report, a preliminary survey was made of the situation and a site for the station selected. This was privately owned ground, no public land being available. The owner was not a resident of Guam, and after several months, negotiations were ended, the price asked being considered unreasonable. Another tract, belonging to Juan Torres, a resident, was chosen and late in December was leased, with the privilege of purchase. This area consists of about 27 acres, located along the road from Piti to Agaña, and so situated that it can be irrigated from the Maso River without any great expense. This stream forms the western boundary of the land. The main portion of the tract is flat, but it extends into the low hills on the south and offers opportunity for experiments both in valley and savanna cultures.

Work was begun at once after securing the lease and the land cleared of a tangle of tropical growth and preparations made for some experimental investigations. Fencing materials were sent out from San Francisco and a portion of the cleared tract inclosed. Some temporary buildings have been begun to shelter the employees, stock, and implements.

A period of unusual drought was experienced in Guam early in 1909, and as a result it was impossible to make much headway with the planting. The experiments with forage plants are making some progress. The Guinea grass and the Bermuda grass sent from the Hawaii Agricultural Experiment Station were planted, and these forage plants appeared to be doing well considering the dry season.

Three varieties of sorghum have been planted to test their adaptability for forage. In order to increase the amount of forage and restore the former fertility of the soil, a number of varieties of leguminous plants have been introduced, to be grown between the rows of sorghum. As soon as other areas are available the forage-crop plantings will be extended. The recent drought emphasized the necessity of the introduction of forage plants, as cattle and other stock were forced for several weeks to live on the leaves and twigs of trees. It also calls attention to the urgent necessity of extending agricultural production, as special importations of rice and other food stuffs were required to relieve the suffering of the people.

A considerable number of pineapple plants, several varieties of bananas, and a number of avocados from Hawaii have been planted and reported as growing vigorously. These varieties are believed to be superior to those already growing in Guam, and they should prove to be valuable additions to the economic plants of the island. Other economic plants have been introduced from Java and elsewhere, and as rapidly as supplies are on hand they will be distributed to the people for cultivation.

An experiment has been begun to determine the possibility of reclaiming some of the savanna lands that are now of little value. These soils are low in nitrogen and organic matter, and are very retentive of moisture. A small area has been prepared and planted to *Leucæna glauca*, a leguminous shrub or small tree. This plant in itself is of no great economic value, but it is thought that it will grow on the savanna soils and after becoming established will serve as shade for more valuable species.

Among the experiments that have just been inaugurated are tests of different varieties of corn in comparison with the form now generally grown in Guam, breeding experiments with corn, coconut planting, introduction and testing of varieties of vegetables, etc. Some studies have been begun on certain plant diseases and insect pests, and these will be continued as fast as possible. An introduction has already been made from Hawaii of ladybirds, which it is hoped will aid in combating the mealy bug on the coconut.

At the end of the fiscal year Mr. J. B. Thompson, a graduate of the Kansas Agricultural College, who had had several years' experience with the Bureau of Agriculture in the Philippine Islands, was placed in charge of the station and made its temporary disbursing officer, with Mr. H. L. V. Costenoble as assistant. This arrangement will not change in any way the policy of the station, but will bring it more under the influence of American agriculture as developed through the agricultural colleges and experiment stations.

The work of this station for some time will consist principally of demonstrations in methods of agriculture and the introduction and testing of field and horticultural crops. Already the people are beginning to exhibit an interest in the work, and a considerable number of requests for advice have been received. Cooperative experiments have been begun in a limited way with a few farmers, and seeds of field and garden crops have been gladly accepted for trial plantings by quite a number of actual farmers. It is hoped that arrangements can be made for regular supplies of seeds for distribution, as only in this way can an interest in new crops be aroused. In the tropical climate of Guam the vitality of most seeds is soon lost and there are no supplies available for purchase. In order to provide for the necessities of the people limited quantities of seeds should be forwarded on the sailing of each transport from San Francisco. In this way more people could be furnished with viable seed than is now possible.

IRRIGATION INVESTIGATIONS.

Prof. Samuel Fortier continues to have charge of the Irrigation Investigations of this Office.

The rapid extension of the area under ditch and ready for settlement during the last few years and the large amount of advertising done by promoters of irrigation enterprises have created a heavy demand on this Office from possible settlers for information of two general classes: (1) General information regarding conditions in the arid region—climate, water supply, crops grown, cost of water, cost of land, and cost of establishing farms under irrigation; and (2) practical information regarding methods of securing water supplies, of preparing land for irrigation, and applying water to crops. It is believed that in supplying this information this Office can be of greater service to both the intending settlers and the communities to which they expect to go than in any other way. Consequently the preparation of bulletins containing this information was made the leading feature of the work during the last fiscal year.

Arrangements were made for the preparation of a report on irrigation conditions in each of the arid States and Territories, most of these being prepared by the state or territorial engineers of the respective commonwealths, and where this office does not exist other local parties familiar with the water resources and agricultural conditions were employed to prepare the reports. Seven of these reports were published during the year, and the others are either in hand ready for publication or are in preparation. The demand for these bulletins has been so great as to amply justify their publication. Parties interested naturally turn to this Department for reliable information regarding conditions in the sections advertised, and the bulletins included in this series should be of great service in the settlement of the lands being reclaimed, by calling attention to the opportunities afforded by these lands and at the same time informing intending settlers as to the conditions which they will find and the expenses which will be incurred.

The settlers for the lands being brought under ditch must come principally from sections where irrigation is not practiced. They need not only the information regarding climate, crops, and general conditions contained in the bulletins just mentioned, but even more they need practical directions as to how to perform those operations connected with crop growing in the new sections which are peculiar to irrigated land. Most of these settlers are from agricultural sections, and are therefore familiar with growing the standard farm crops, but they are wholly ignorant of the use of water in irrigation. For this reason a series of bulletins covering the irrigation of the standard crops is being prepared. During the summer of 1908 the regular field force of this Office and a number of special agents were engaged in collecting information as to the best practice in all the irrigated sections of the West, and during the winter of 1908–9 a part of this material was prepared for publication, bulletins on the irrigation of alfalfa and sugar beets being completed and ready for publication. Similar bulletins on the other crops commonly grown are being compiled in the same way. These bulletins deal in a practical way with preparing land for irrigation by various methods, the building of farm ditches and structures for distributing water to the fields, and applying water to the land, and with other operations connected with the use of water for irrigation. The establishment of a home on new lands is always a difficult undertaking, in which many fail, but it is doubly so when there is added to the usual labor and expense the burden of leveling land, building ditches, and applying water, with all of which the settler is unfamiliar. Settlers must learn much by experience, but plain descriptions and directions, such as are contained in these bulletins, will increase very greatly the chances for success on the part of these settlers. There has been a large call for these bulletins, both from settlers and from the builders of irrigation works, who recognize that they can succeed only through the success of the water users.

The men of the field force of the Office devote as much of their time as possible to aiding settlers by personal advice and by delivering addresses, but the efficiency of the work would be greatly increased by the establishment of demonstration farms on which all the standard methods of preparing land and controlling and distributing water should be illustrated. The one feature new to settlers in the arid region is the use of water, and the primary purpose of all demonstration work in this region should be showing the settler how to use water. Some of the state experiment stations have established substations in newly irrigated sections for the purpose of experiment and demonstration, and this Office is cooperating in the operation of these stations, notably in California, Washington, and Idaho. This work might be extended to advantage, making the main feature at each farm the illustration of methods of using water.

While the most pressing agricultural need of the arid region just now is for practical directions regarding the use of water, for the incoming settler, ultimately the greatest need will be a more economical use of the limited water supply. For this reason much attention is being given to the study of methods of preventing the enormous losses of water which previous investigations have shown to exist. These measurements have shown that water is lost by percolation and evaporation from the point of its diversion into canals until its final dissipation after being applied to fields, the total of these losses equaling from one-half to three-fourths of the quantities diverted. The checking of these losses offers the greatest opportunity for the future extension of the irrigated area in the United States, since the total water supply will reclaim only a small part of the available land of the arid region.

The greatest losses arise from seepage from earthen canals, and this Office is carrying on experiments to determine the cost and effectiveness of different canal linings and methods of treating the bottoms and sides of canals to lessen seepage.

It is possible to prevent seepage by lining canals with cement plaster or concrete, but the cost is too great for the crops grown in many sections, and the real problem is to check the losses at a cost which can be repaid from the crops grown. Every saving effected is equivalent to a new supply of an equal volume, with the added advantage that the water saved would not only have been lost, but would have injured the lands into which it seeped.

Further losses occur when the water is applied to the soil, due to evaporation into the air and percolation into the subsoil beyond the reach of plant roots. That these losses are large and that they are checked by applying water in such a way that the top soil is not saturated and by cultivation after irrigation has been a matter of common knowledge for many years, but there has been no exact knowledge as to the extent of the losses or the effectiveness of the means adopted to check them. Experiments to determine these questions were begun by this Office, in cooperation with the State of California, in 1905, and have been continued since that time. The results from these experiments were so good that it seemed best to extend the experiments to other places with different soil and climatic conditions, and consequently in the season of 1908 the necessary equipment was installed at Reno, Nev.; Bozeman, Mont.; Agricultural College, N. Mex.; and Kennewick, Wash.; and in the spring of 1909 at Williston, N. Dak., and Caldwell, Idaho. Similar experiments in applying water by different methods and following irrigation by different degrees of cultivation are carried on simultaneously at these points. The principal value of these experiments will be in giving exact knowledge of the magnitude of the losses from evaporation and a quantitative measure of the effectiveness of different methods of applying water and of subsequent cultivation. The possession of this knowledge will do much toward preventing the losses.

Studies of the use of power for irrigation were continued during the year, special attention being given to the possibilities of the use of windmills for irrigation in the semiarid States. This work consisted of mechanical tests of several mills at Cheyenne, Wyo., in which accurate records of the work done in various wind velocities and of the labor and expense necessary for maintenance and repairs were kept, and in the collection of data as to the work being done by mills in use for pumping water for irrigation on the Great Plains. Technical and popular reports of these investigations have been prepared. Studies of pumping in California and in the rice districts of Louisiana and Texas have been continued.

The investigation of irrigation practice in the rice districts of Louisiana and Arkansas carried on for several years were continued during the year, a popular bulletin on small pumping plants having been published and a report dealing with irrigation practice in rice growing designed especially for beginners in this industry has been prepared but is not yet published. These studies of irrigation of rice are being continued during the present year.

The principal field for the irrigation work of this Office is in the region where irrigation is necessary to the carrying on of agricultural operations, but there are large sections where farming can be carried on without irrigation, but where irrigation may prove to be of great value as an aid to a higher class of farming and as an insurance against drought. This is especially true of the Great Plains, which have been settled very rapidly during the last few years. In the belief that the irrigation of a small area in connection with the farming of a larger area without irrigation will do much toward making the recent development permanent and profitable, this Office has for several years maintained farms at Cheyenne, Wyo., Eads, Colo., and

Newcastle, Wyo., where the problems of this type of irrigation are being worked out and the irrigation methods adapted to that region are being demonstrated. It is planned to continue these farms for a few years more at least.

The problems connected with irrigation as a supplement to farming without it are also being studied in the Willamette Valley, Oregon. Experiments are being carried on in cooperation with local farmers to determine both the advantages to be derived from irrigating during the dry summer months and the methods best adapted to local conditions.

Even in the humid regions the practice of irrigation is extending rapidly in the growing of high-priced fruit and truck crops. In the season of 1908 this field was deemed of sufficient importance to justify the assignment of a man to it. The methods in use are expensive and in many cases not well adapted to conditions, and our agent, who is familiar with western methods, has been of great service to those undertaking irrigation in the East. This work will expand rapidly and will demand more attention in the future.

WORK IN FISCAL YEAR 1910.

It is proposed to continue the work along the same general lines as were followed in 1909. Additional bulletins of the series on irrigation in the several arid States and Territories will be published and also additional bulletins of the practical series dealing with the irrigation of the standard crops of the arid region. In connection with the collection of information for these bulletins, views showing the various operations connected with applying water to crops and the implements used are being secured and lantern slides are being made from these for use in popular lectures on methods of irrigating to be delivered by members of the force during the winter in the sections where settlement is most rapid and the need for the spread of such information is greatest. It is believed that this will be a very valuable supplement to the practical bulletins along these lines, and will do much to promote better methods and help the settlers to do their work to best advantage.

The experiments in ditch linings for checking seepage losses will be continued at Davis, Cal., while the tank experiments to determine evaporation losses and the effectiveness of methods of checking these losses, carried on at various points, will be continued. Field experiments to determine the quantities of water required for irrigation will be continued. As the demand for assistance to settlers decreases, more attention will be given to scientific studies which have for their purpose a more exact knowledge of the quantities of water required for crop production, the best methods of applying water to secure its proper distribution in the soil, and to prevent its loss by evaporation or percolation.

In the investigations of the use of power for irrigation the work will be about equally divided between advising parties who are installing pumping plants and the studies necessary for the preparation of a practical bulletin on engine pumping plants, to follow the bulletin of the same character on windmill pumping plants, prepared in 1909.

The farms in the semiarid region will be operated during this season and should be continued during 1911, while the work of similar character on the Pacific slope should also continue.

In the humid region cooperative experiments with several farmers in the Gulf States have been arranged, in which these farmers are doing the work under the direction of the agent in charge. In the trucking districts of Florida more such experiments are being carried on.

WORK IN 1911.

The work to be done in 1911 should be a continuation of that now being done. The demand for practical information from settlers on lands now being brought under ditch will probably continue, and perhaps increase, and so long as this is the case, a large part of our work should be the supplying of this information through bulletins, lectures, personal advice, and demonstration farms. This work can be indefinitely increased, with profit to the settlers and the country, or it can be carried on to good advantage on its present scale. The enlargement of this practical work should not be allowed to encroach upon the work of investigating methods of using water and preventing losses, because these are fundamental and ultimately of more importance than the other lines because of the limited supply of water as compared with the need for it. The immediate need is to prevent the loss of the time and means of the new settlers, but ultimately agricultural extension in the arid region will depend upon a more economical and scientific use of water.

DRAINAGE INVESTIGATIONS.

Mr. C. G. Elliott continues to have charge of the Drainage Investigations of this Office.

During the past year the unfinished drainage projects of the year previous have been completed and many new projects and investigations taken up. A summary of the work done embraces surveys, working plans and profiles, and reports made for these various drainage districts, which may be classed as follows:

DRAINAGE SURVEYS.

I. *Reclamation of lands subject to overflow, as by floods.*—Arkansas: Village Creek and White River (Jackson County), Village and Running Water Creeks (Lawrence, Randolph, and Jackson Counties), St. Francis Basin. Georgia: Mulberry River (Jackson County). Illinois: Little Wabash and Skillet Fork Rivers. Indiana: Kankakee River (report printed). Mississippi: Coldwater River, Tuscumbia River. Nebraska: Logan Creek, Silver Creek (Merrick County), Salt Creek, Wahoo Creek. North Carolina: Moyock, Cape Fear River Levee. Oklahoma: Deep Fork of the Canadian River. South Carolina: Congaree River (Richland County). South Dakota: Vermilion River.

II. *Reclamation of lands continually wet—swamps, etc.*—Arkansas: Plum Bayou District (Jefferson County). Delaware: Cedar Swamp (Sussex County). Florida: The Everglades. North Carolina: Lake

Mattamuskeet, Angola Bay Swamp. South Carolina: Sampit Swamp (Georgetown County).

III. *Improvement of natural water courses or construction of new channels to provide outlets.*—Arkansas: Lonoke. Maryland: Pocomoke River. Mississippi: Bolivar County (report printed), McKinney Lake. Nebraska: Lexington (Dawson County). North Carolina: Chadbourn (Columbus County), Pantego Creek. South Carolina: Stoney Plantations and Clarke's Plantation (Berkeley County).

IV. *Farm drainage.*—Georgia: Berry School Farm. Oregon: Albany. South Carolina: Coast Lands Experiment Station (Jedburg), Bourne & Co.'s. field and J. B. Steele's farm (Georgetown County), A. E. Gonzales (Columbia).

V. *Drainage of irrigated lands.*—California: Fresno. Colorado: California Mesa. San Luis Valley. Grand River Valley. Texas: Brownsville. Utah: Box Elder, Millard, Sevier, Utah, Washington, and Emery Counties. Wyoming: Laramie (state experiment farm).

PRELIMINARY EXAMINATIONS AND CONSTRUCTION WORK.

Preliminary examinations have been made and reports written upon the following:

Alabama, Sipsey Creek; Arkansas, Jefferson County; Georgia, Berry School Farm (Rome); Illinois, Inlet Swamp (Lee County); Indiana, Lower Yellow River Valley; Kansas, the Valley of Marais des Cygnes, Straight Creek Valley (Jackson County), Verdigris River, Little Caney River; Mississippi, Black Creek Area (Holmes County); Missouri, Drainage District No. 1 (Clark County); Nebraska, Salt Creek, Wahoo Creek, Nemaha River; North Carolina, Lake Mattamuskeet, Lake Phelps, Pungo River; Oklahoma, drainage conditions; Tennessee, Lawrenceburg, Western Experiment Station (Jackson County); Virginia, Chickahominy Swamp, drainage of farm lands in Dismal Swamp, Little Roanoke River; Washington, Wapato irrigation project (Yakima Valley).

The following projects for which this Office has made surveys and prepared plans are now under construction by landowners:

Arkansas, Boggy Bayou Drainage District (Desha County); Kansas, Deming Ranch (near Oswego); Louisiana, Coolie drainage district (near Collinston); Mississippi, Coahoma County district (near Clarksdale); North Carolina, Toisnot Swamp (Wilson County); North Dakota, Clay Creek Ditch (Clay and Yankton counties).

GENERAL TECHNICAL INVESTIGATIONS.

Special investigations have been carried on to determine: The run-off from various Louisiana lands where pumps are required to remove the water; the run-off in the southern Mississippi Valley; the run-off in Illinois from drained farm lands; the proper methods of draining irrigated lands affected by alkali or seepage, or both; the effect of alkali solutions on cement when briquettes are stored in, or gauged with, alkali solutions, for the purpose of ascertaining the practicability of using cement drain tile in alkali lands; the best methods of draining alkali lands in the Rio Grande Valley, Texas; the best methods of reclaiming turf and peat lands in northern States; the best methods of draining salt marsh lands of the Atlantic coast.

Mr. Elliott, Chief of Drainage Investigations, also made an extended examination during the summer of 1908 of land drainage as practiced in the fens of England, the lowlands of Holland, and the moors of Germany.

DISSEMINATION OF INFORMATION.

The Washington office, in addition to its regular correspondence, has carried on extensive correspondence of an advisory nature, in response to inquiries relating to drainage problems throughout the United States, and, through its corps of engineers, has rendered much assistance by personal consultation with individuals and officials of drainage districts.

Public drainage meetings were addressed by different members of the staff in Arkansas, Delaware, Louisiana, Maryland, and North Carolina. New state drainage laws have been enacted by the legislatures of Colorado, Arkansas, and North Carolina, members of the staff having assisted in drafting the laws of the latter two States. Three lectures on drainage subjects were delivered at the Graduate School of Agriculture, Cornell University, New York, during the summer of 1908.

WORK PLANNED FOR THE FISCAL YEAR ENDING JUNE 30, 1910.

In response to calls from the widening field of drainage in the irrigated sections of the West, examinations and experiments will be carried on in the Rio Grande Valley, Texas, where the need of drainage in connection with irrigation and badly distributed rainfall is required. The desire of the people of both the Grand River Valley and the San Luis Valley to begin active drainage operations following the report of the investigations made by this Office in 1907, suggests the wisdom of adding to the engineering staff in those localities in order to plan and supervise the construction of some of the work first undertaken, since it will, in a measure, be experimental. The drainage investigations in Utah will be directed by this Office, one-half of the expense being provided by an appropriation made by the last legislature. The work will consist largely of advisory and engineering assistance which will be furnished to landowners who contemplate reclaiming their wet lands. During the winter season a part of the field force will be engaged in the development of plans for draining lands in the South, where interest in this subject is growing rapidly. Surveys and estimates made in greater or less detail are required in many instances in order to ascertain the practicability of special drainage works. Special investigations will be continued to determine the most efficient and economical methods of draining lowlands where pumps are required; to ascertain the run-off from lands of different classes which should be provided for by drains, and also the practical and economical methods of draining tidal lands for agriculture. It is expected that a wider publicity will be given to the results obtained in various lines of drainage investigations by means of printed reports than has been done heretofore.

WORK PROPOSED FOR THE FISCAL YEAR ENDING JUNE 30, 1911.

The continual demand for the reclamation of swamp and wet lands of the country will develop new problems for solution, and hence constant calls will be made upon the Office for special drainage examinations, surveys, and reports. The general class of investigations and surveys heretofore conducted should be judiciously distributed where local interest will warrant them, the purpose of which should be twofold: The solution of perplexing land-drainage problems, and the establishment, by example, of general methods and principles which underlie the treatment of land reclamation projects, for the instruction of agricultural communities. The increasing demand upon members of the staff for expert opinions upon the sufficiency of plans which have been made by local engineers should, if possible, be met by a competent advisory board in this Office. The Office should, upon application, furnish directions for the preliminary work which is required in properly inaugurating drainage projects. It is proposed to continue the policy of assisting farmers as far as practicable in correctly starting the reclamation of their wet lands and to give increasing attention to special scientific investigations pertaining to land drainage.

NUTRITION INVESTIGATIONS.

During the year ending June 30, 1909, the respiration calorimeter has been installed in the quarters set apart for it in the new Department of Agriculture building. Bulletins and reports have been prepared for publication, and editorial work has been carried on as usual. In the reconstruction of the respiration calorimeter many improvements have been introduced which make it more easy and economical to operate, and which insure greater sensitiveness and accuracy. The tests which have been made show that the work has been successfully carried out and that the objects sought have been attained.

During the fiscal year 1910 it is proposed to study with the respiration calorimeter a number of questions concerning the nutritive value of important agricultural products. The relative value as food of cream, butter, lard, olive-oil, and other culinary fats is one of the problems to be studied, as is also the rate and ease of digestion of cheese of different kinds in comparison with other foods. Such data are needed in order to secure information necessary to complete studies of the nutritive value of cheese which have been made in cooperation with the Bureau of Animal Industry.

The respiration calorimeter, it is believed, offers a new and valuable method for measuring the effect on metabolism of various additions to food materials, as it permits of the measurement of a number of factors with an accuracy which can not be attained in any other known way. Work will be carried on in cooperation with other bureaus whenever such an arrangement will further the interests of the Department and insure economy of effort.

Many diverse statements are made regarding the effects of the use of meat on the body. It is therefore important that full data should be available regarding this extremely valuable agricultural product.

For this purpose it is proposed to study questions concerning the value of meat as food by the improved methods which are now available.

Questions of food in relation to the production of useful work are also of importance, and with the respiration calorimeter may be as readily and satisfactorily studied as can the relation of fuel to the production of work by an engine, by the usual methods at the disposal of the investigator.

The respiration calorimeter affords an opportunity for studying such problems as those outlined and many others under very favorable conditions, as it permits of the rapid and accurate measurement of a large number of factors which are of the greatest importance in drawing trustworthy deductions.

Three technical bulletins, three farmers' bulletins, and several articles and summaries for annual reports have been submitted for publication during the year ending June 30, 1909. Several technical and popular bulletins have been edited which await publication.

As heretofore, abstracts of articles on nutrition have been prepared for publication in the Experiment Station Record, and popular summaries of data, particularly nutrition work of the experiment stations for publication in the series of Farmers' Bulletins entitled Experiment Station Work. The correspondence and other general work necessitated by the nutrition investigations have been carried on as usual.

The marked growth in correspondence, in requests for information and for nutrition publications, is an indication of the widespread and general interest in the work on the part of home makers on the farms and in towns, as well as of students, teachers, physicians, and investigators.

REPORT OF THE DIRECTOR OF THE OFFICE OF PUBLIC ROADS.

United States Department of Agriculture,
Office of Public Roads,
Washington, D. C., October 25, 1909.

Sir: I have the honor to submit herewith the report of the Office of Public Roads for the fiscal year ended June 30, 1909, and also an outline of the work planned for the current and ensuing years.

Respectfully,

Logan Waller Page, *Director.*

Hon. James Wilson,
Secretary of Agriculture.

WORK OF THE YEAR.

It is probable that no subject is engaging the attention of state legislators at the present time in a greater degree than road improvement. More than half the States have adopted the principle of state aid and supervision over all or part of the roads, while the remaining States are seriously considering sweeping reforms in their road laws. This has brought about a steady progress in road building. The expenditures from state treasuries have reached a total of nearly $60,000,000 annually, practically all of which has been devoted to the building of hard roads, while many counties have issued bonds in large amounts for this purpose. Back of all this activity is a powerful and growing public sentiment, which is making road improvement one of the foremost economic questions of the day. These conditions are responsible for a greatly increased demand upon the Office of Public Roads for information and assistance in every branch of the work.

It has been impossible to meet, except to a small degree, the needs of the country; but, through the earnest and untiring efforts of the entire personnel of the Office, and by means of the cordial cooperation which has been steadily maintained with state officials and various scientific and other organizations, a far greater amount of work has been accomplished than in any previous year since the establishment of the Office.

The appropriation for the last fiscal year was $87.390, an increase over the previous year of $17.340. With this appropriation the Office cooperated in the construction of 71 object-lesson and experimental roads, as compared with 31 for the previous year. The total surface area in square yards was 690,059, as compared with 223.208 square yards for the previous year. This showing is particularly gratifying in view of the fact that the aggregate amount of work performed in 1908 far surpassed the amount of work in any year previous to that. It has been the policy of the Office to recommend the construction of only such roads as seemed best suited to local conditions, means, and requirements, and to utilize the equipment locally available, so that the work could be successfully carried on after the departure of our engineers. This policy has resulted in a widespread use of the sand-clay method, greater attention to grading and drainage for earth roads, and successful experiments in special forms of construction devised to meet special conditions. It is the tendency of the overenthusiastic road advocates to insist upon the building of costly macadam roads without regard to the local conditions which should determine the form of construction, while, on the other hand, it is the policy of the ultraconservatives to retain antiquated, ineffective, and costly methods of maintenance. The engineers of this Office are instructed to cooperate only where it is found practicable to obtain the adoption of a policy which avoids the extremes of conservatism and radicalism.

The experimental work of the Office has within the last few years assumed an importance second only to that of the general object-lesson work. The problem now before highway engineers is to save from the destructive action of the automobile the macadam roads already built at great cost and to devise a method of construction which will successfully withstand the destructive effects of such traffic in the future. The efforts of this Office, as well as of highway engineers generally in this country and in Europe, have been directed, first, toward obtaining a preservative and binder which may be applied to the surface of roads already constructed, rendering them dustless and forming a bond of sufficient strength to withstand motor traffic; second, toward ascertaining the most suitable binder or binders to be incorporated with the other materials so as to produce a dustless road powerfully bonded; and finally, toward discovering a means of keeping the cost within reasonable limits.

The field experiments conducted by the Office during the past year are given in detail elsewhere in this report, but it may be mentioned here that extensive and careful experiments have been made with asphalt, tar, and various other bituminous binders, waste product from sugar refineries, sulphite liquors from pulp mills, and with various palliatives, such as oil emulsions, calcium chloride, light oils, etc. The experiments have in many cases been successful, and the problem seems to be resolving itself more into one of reduction in cost by the development of local materials and methods. These problems were responsible for the meeting at Paris, France, in October, 1908, of the most important road convention ever assembled, at which 29 countries were officially represented by delegates. The Director of this Office was selected as the chairman of the commission of three representing the United States Government, and in this capacity participated actively in the proceedings of the convention. The results of the convention were believed to be of great value, and a second convention was decided upon, to be held at Brussels.

While the most important feature of the experimental work may be considered the adaptation of roads to modern traffic, it must not be understood that this is the only important problem now before highway engineers. The great cost of building crushed-stone roads, and the remoteness of hard materials from certain sections of the country, have made it imperative that cheaper substitutes be found for crushed stone. There are over 20,000,000 tons of slag produced annually, much of which has no commercial value. Experiments of this Office have been directed toward utilizing this waste material in the construction of roads. In the Mississippi Delta district the experiments begun several years ago with burnt-clay roads have continued and have been almost uniformly successful. The sand-clay method, which has proved so successful in the South, has, during the past year, been introduced into the States of Kansas, Nebraska, and Iowa, and the details of construction are given in this report. So successful has the work in Kansas proved that a bulletin is in the course of publication, dealing with the various steps taken and the results accomplished. The success of this method of construction in the trans-Mississippi States will be of inestimable value to the people of that great section of the country, for the reason that very little suitable hard material is available there for road building.

Arrangements were made during the spring of 1909 with Cornell University and the New York state highway commission for the most complete series of experiments ever made to determine the relative efficiency of various types of roads and of road binders. The work was not begun, however, until after the close of the fiscal year, and will therefore be included in next year's report.

The lectures given by representatives of the Office during the past year were fewer in number than in 1908, the total being 185, as compared with 200 for the previous year. This was due not to a lack of demand for this character of assistance nor to any weakness or inefficiency in the project, but rather to the tremendous demand for assistance in actual construction work, which made it necessary to withdraw our engineers from the lecture platform. It is unfortunate that this should be necessary, because reforms in systems of road legislation and administration are essential to the success of the road builder, and in order that these may be brought about, public sentiment must be aroused and given the proper direction. For this purpose lectures are invaluable. The people, particularly those having to deal with the administrative and financial phases of road work, should have a general knowledge of the subject and a grasp of its requirements, such as they can obtain through the medium of practical instructive lectures. It is the strict policy of the Office to discourage the delivery of addresses and lectures for the sake of entertainment, and only those branches of the subject are dealt with which will prove of local benefit.

The advisory work of the Office, aside from the object lessons and lectures, is divided into two classes, one known as the introduction of model systems and the other as special advice and inspection. The model-system work involves extended assignments during which an engineer of this Office investigates the entire road system of a county, its road materials, its system of construction, maintenance, and administration, its equipment, and, in fact, every feature of the work, and this investigation is then summarized in an exhaustive report, which sets forth, in addition, the recommendations of the engineer for the betterment of the roads of the county. Five counties have received assistance under this project during the last year. The second class comprises temporary assignments for the purpose of investigating local problems and giving advice. There were 142 such assignments during the past fiscal year.

An interesting feature of the year's work was the exhibit of the Office at the Alaska-Yukon-Pacific Exposition, held at Seattle during the period from June 1, 1909, to October 16, 1909. The exhibit attracted general attention and undoubtedly did much to stimulate interest in the subject of road building.

The Office has cooperated with the Forest Service in the location of forest trails through forest reserves; with the Geological Survey and various state geological surveys in the investigation of road materials; with the American Society for Testing Materials in standardizing tests for road materials and evolving tentative specifications for bituminous road binders; with the Post-Office Department in the inspection and improvement of rural delivery roads; with state experiment stations in devising ways and means for joint work; and with the Isthmian Canal Commission in tests of materials. In addition, a great deal of work was conducted in cooperation with state highway departments and leading scientific institutions and this policy has resulted in added efficiency to the Office. In North Carolina a representative of the Office was assigned to cooperate in the formation of a state highway division. In Louisiana four engineers of the Office are aiding in the inauguration of a system of convict labor on the public roads. At Cornell University, as already mentioned, cooperation with that institution has been brought about with the view of obtaining data in regard to the relative value of various road binders and types of road. A large number of tests of road materials have been made upon the request of state geologists and state highway departments.

Instruction to engineer students was continued in the same manner as in the previous year, with the practical experience in the field and laboratory supplemented by lectures, theoretical instructions, research work, and the preparation of papers. An investigation was made, by means of correspondence with the engineering departments of leading schools and universities throughout the United States, to ascertain the status of highway engineering, the prospects of broadening the scope of instruction, and the possible lines of cooperation between this Office and educational institutions. Undoubtedly the educational institutions of this country are now devoting more attention than ever to the importance of the subject of highway engineering.

The investigation covering road construction, maintenance, and administration in foreign countries carried out under the direction of the State Department through consular officers was completed during the year. The collection of data relating to road administration, construction, and maintenance in this country was arranged for during the past year by the reorganization of the corps of public-road correspondents and the preparation of a series of questions to be sent out from this Office at the beginning of the current fiscal year.

The Office provided itself with a specially designed equipment for making traction tests on various road surfaces of different grades and with tires of various widths. Some interesting results were obtained, which will be given in an official publication later.

In connection with the object-lesson road work, the lectures and the general advisory work of the Office, the use of the split-log drag for the maintenance of earth, sand-clay, and gravel roads has been most earnestly urged, and its construction and operation thoroughly explained and demonstrated. This simple device is capable of working a transformation in many of the public roads and it is gratifying to note that its use is becoming more general year by year.

The detailed reports covering the work of the year are given under the head of the various projects.

OBJECT-LESSON ROADS.

Object-lesson roads are constructed for the purpose of demonstrating practical methods of road building and to give elementary instruction to local road builders. The Office supplies, at government expense, one or more engineers for the purpose of making necessary surveys, estimates and specifications, supervising construction, and giving theoretical instruction, while the local authorities are required to furnish necessary machinery, materials, labor, teams, etc. During the past year 8 roads which had been begun in the preceding year were completed, 57 were begun and completed during the year, while 6 remained unfinished on June 30, 1909, and will be reported in the next annual report. This makes a total of 71 roads worked on during the year. Classed according to the form of construction, these roads were as follows: Twelve macadam, 26 sand-clay, 7 gravel, 10 earth, 1 shell, and 15 experimental. Of the experimental roads, 8 were sand-clay, 1 burnt-clay, and 6 were roads in which oil, tar, or asphaltic products entered as a binder. For the purpose of comparison the following table is given, showing the number of square yards of each type of road constructed during the years 1905, 1906, 1907, 1908, and 1909.

Object-lesson roads constructed during 1905, 1906, 1907, 1908, and 1909.

Material.	1905.	1906.	1907.	1908.	1909.
	Sq. yards.	*Sq. yards.*	*Sq. yards.*	*Sq. yards.*	*Sq. yards.*
Macadam	44,944	51,246	76,376	72,587	96,107
Gravel	8,804	4,197	11,722	4,608	65,793
Shell	5,877	933		14,020	1,630
Earth		12,132	27,042	85,967	319,456
Sand-clay	19,178	19,443	85,571	42,634	205,032
Burnt-clay	400			3,392	2,041
Total	79,203	87,951	200,711	223,208	690,059

This table shows a decided increase in the amount of the earth and sand-clay roads built, and thus illustrates the policy of the Office in advocating those forms of construction best suited to local conditions and local means. Experience has shown that our earth roads can, in general, be very much improved by proper construction and systematic maintenance at a cost well within the reach of almost any community. Furthermore, these improved earth roads serve as the best possible foundation for further improvements with a hard surface as means become available. Sand-clay has proved a satisfactory substitute for macadam in many sections of the country and this Office is encouraging a more general use of this method of construction. To establish the value of this form of construction in cold climates a number of experimental sand-clay roads were constructed in the Middle Western States.

MACADAM ROADS.

STOCKTON, CAL.—On May 18, 1908, work was begun in building 11,080 feet of 16-foot macadam road with oiled surface, from Stockton in a southeasterly direction toward Collegeville, and during its construction only one hour was lost on account of bad weather. The road was completed September 21, 1908. The adjacent country is very level, with heavy black adobe soil. In excavating this material, ten-horse plows and rooters were used. Since the average haul was 50 feet, slip scrapers were used. Three 18-inch corrugated pipe culverts with concrete end walls were constructed, at a cost of $236.33. The local authorities furnished machinery as follows: Slips, plows, blade machine, dump wagons, 22-ton steam roller, 6-ton horse roller, slat-bottom wagons, fuel-oil wagon, oil tank and spreader for applying oil to road, shovels, rakes, etc. The stone used was a hard and tough andesite, which was shipped 70 miles by rail, with an average haul from car to road of 6,800 feet. The foundation course of from ¾-inch to 2½-inch stone varied in thickness from 4½ inches at the sides to 5½ inches at the center. The second course of ⅜-inch to 1½-inch stone varied from 1½ inches at the sides to 2½ inches at the center. The surface course consisted of oil and stone screenings. For surfacing, 525.3 barrels of oil were used, at the rate of 1.18 gallons per square yard, and the total cost of the application amounted to $693.15. The cost of stone, at $1 per ton f. o. b. Stockton, was $8,353.40, with labor at $2.50 and teams at $5 per day, and the total cost of the road, including culverts, was $1 per square yard, or $9,462 per mile. The apparently high cost of this road was due to the difficult excavation, which was done at an expense of $2,598.96, and to the long haul of stone from car to road, at a cost of $3,265.10.

DEPARTMENT OF AGRICULTURE GROUNDS, WASHINGTON, D. C.—This work consisted in building macadam approaches to the new Agricultural Department building at Washington, D. C. The work was done under contract, under the direction of an engineer from this Office. With the use of plows 77.6 cubic yards of earth were excavated and hauled away in carts at a cost of $0.83 per cubic yard. Seven hundred and ninety-five feet of subgrade were prepared and surfaced with stone to a finished depth of 6 inches, after being well rolled. The stone used was a hornblende schist, and the first course was 4 inches thick, while the second was 2 inches thick, with just enough screenings to insure a well-bonded surface. A total of 1,148 square yards was surfaced at a cost of $0.98 per square yard, or at the rate of $6,899 per mile of road 12 feet wide. These figures are based on labor at $1.50 per day, single teams at $2.25, double teams at $4.50, and fuel for steam roller at $3.75 per ton.

ATLANTA, GA.—A length of 150 feet of macadam road was built at Atlanta, Ga., as a demonstration during the fair, October 19 and 20, 1908. The road was graded to a width of 24 feet, of which 16 feet were surfaced with stone. Granite was used for the foundation and a mixture of granite and chert for the wearing surface. The stone was placed to a depth of 8 inches loose in three courses of 4 inches, 2½ inches, and 1½ inches each. Machinery and materials were donated by the city of Atlanta, and convict labor was used for the excavation and to spread the stone.

LOGANSPORT, IND.—On August 6, 1908, grading was begun preparatory to building a macadam road at Logansport, and the work was completed on November 4, 1908, with a loss of two and one-half days on account of bad weather and fifteen days because of lack of stone. The road was constructed through hilly country with a loamy soil, requiring, for drainage purposes, 104 feet of 8-inch, 71 feet of 12-inch, and 24 feet of 15-inch vitrified pipe, together with 752 feet of 6-inch tile for underdrains. A concrete culvert 2 feet by 4 feet and 27 feet long, with reinforced concrete abutment walls, required 15 cubic yards of concrete, 427 pounds of steel rods, and 914 feet of lumber, at a total cost of $112.64. In reducing the existing maximum grade from 6 to 4.2 per cent, 4,633 cubic yards of earth were excavated with plows, scrapers, and wagons at a cost of $0.255 per cubic yard, with an average haul of 400 feet. Much of this excavation consisted in cutting through an old gravel road from 8 to 12 inches thick, requiring the use of six-horse plows and adding considerably to the unit cost of excavation. The limestone used for macadamizing was shipped 13 miles by rail, with an average wagon haul to the road of 2 miles. A total of 5,800 feet of road was graded to a width of from 22 to 25 feet, and 5,750 feet were surfaced to a width of 14 feet. The first course, from 4 to 6 inches thick, was of stone between 1¾ and 3 inches in size; the second course, 2¾ inches thick, was from three-fourths inch to 1½ inches in size; and the third course, 1 inch thick, was of screenings smaller than one-half inch. Thus the finished road, after rolling, was from 5 to 6 inches thick. Since the cost of labor was $1.50 and that of teams from $3 to $3.25, with fuel for steam roller at $4.50 per ton, the cost of this road, exclusive of culverts and grading, was at the rate of $4,441 per mile.

Red Wing, Minn.—Work on the foundation for a 22-foot span concrete bridge with I-beam stringers was begun at Red Wing, Minn., July 7, 1908, and the road was entirely completed October 20, 1908. During this time ten and one-fourth days were lost on account of rain. The location was such as to require an unusual amount of bridges, culverts, drains, and heavy grading, which increased the cost very materially. Permanent bridges, culverts, and drains were completed for 4,000 feet of very hilly roadway; 2,000 feet were graded to a width of 26 feet and 800 feet were surfaced 16 feet wide with granite and limestone. The work required 4,708 cubic yards of excavation, with an average haul of 500 feet, at a cost of $0.221 per cubic yard. The maximum grade was reduced from 10.5 per cent to 6.4 per cent. The metal for surfacing was limestone and granite, shipped by rail a distance of 95 miles, and the cost to the local authorities was $1.86 per cubic yard on the siding, 1,650 feet from the road. The metaling consisted of a 6-inch foundation course of limestone which had passed a 2½-inch screen, a 4-inch wearing course of limestone and granite which had passed a 1½-inch screen, and a 1-inch binder course of stone screenings, the whole of which was compacted to 8 inches of finished roadway. The total cost of the improvement was $3,740.86, of which $1,296.44 was for permanent concrete bridges, culverts, and drains. The cost, exclusive of bridges and culverts, was $0.93 per square yard, or at the rate of $8,730 per mile for a 16-foot roadway. Labor was $1.75 per day, teams $4, and fuel for the roller $5 per ton.

Fayetteville, N. C.—The work of constructing the macadam road at Fayetteville, N. C., was started May 14, 1909, and completed July 3, 1909. The adjacent country was rolling and the soil sandy. Seventy-five feet of 15-inch vitrified pipe were used for drainage purposes. Thirteen hundred feet of road were surfaced to a width varying from 16 to 20 feet, making a total of 2,187 square yards. The macadam work required 630 cubic yards of crushed granite, which was shipped 120 miles by rail, the average haul from car to road being three-fourths of a mile. The foundation course, 5½ inches thick, contained stone from 1½ to 3½ inches in size. This was thoroughly compacted with a 10-ton steam roller and covered to a thickness of 2¼ inches, with a second course of stone between one-half inch and 1½ inches in size, which, after being rolled, was covered with screenings smaller than one-half inch, giving a total thickness after rolling of 5½ inches. The total cost of this road to the community, based on convict labor at $0.40 per day, was $1,972.50, or at the rate of $8,438 per mile of road 16 feet wide. The high cost of this work was due to the long haul of stone by rail, and to the fact that, since no wagons were available, it was necessary to haul the stone to the road in carts of one-third cubic yard capacity.

Tryon, N. C.—A macadam road 3,253 feet in length was constructed at Tryon, N. C., between July 21, 1908, and October 15, 1908. During this time twelve days were lost on account of rain and lack of material. The region traversed was very hilly and the excavation of 3,039 cubic yards of earth and 256 of rock was required to reduce the maximum grades from 12 to 5 per cent, while $460.10 was expended to secure proper cross drainage. Much of the excavation was done by contract at $0.20 per cubic yard for earth and $1.25 per cubic yard for rock. A total of 8,994 square yards was surfaced with an imported granite shipped by rail a distance of 43 miles. The cost of the stone on board cars at the siding, 1,600 feet from the road, was $1.05 per cubic yard. The cars were run up on an inclined trestle and dumped into bins, from which the wagons were loaded by gravity. The lumber for this construction cost $85. The metal was hauled in slat-bottom wagons, with a capacity of 1 cubic yard, and placed in three courses, which when compacted gave a finished depth of about 7 inches. Labor cost $1 per day and teams from $2.50 to $3. The cost of the improvement was $6,938.47, or at the rate of $0.75 per square yard.

Watonga, Okla.—The 3,000 feet of macadam road built at Watonga, Okla., were constructed over a loose blow-sand. The roadway, having been graded and shaped to the desired section, was covered with a layer of clay to a width of 18 feet and a depth of 6 inches. The macadam surface was placed 14 feet wide and compacted 7½ inches deep. Gypsum stone and quarry waste from some plaster mills about 8 miles distant were secured for the foundation course and shipped by rail to a siding 1½ miles from the road. A fair grade of dolomite was secured from a quarry about 12 miles distant and was used for the surface course. The stone crusher was set up at the siding and the crushed stone was elevated into bins, from which the slat-bottom farm wagons which were used in hauling and which had a capacity of 1½ cubic yards were loaded by gravity. The surfacing material cost an average of $0.865 on the cars at the siding. The cost of crushing was $0.377 per cubic yard, while hauling the stone from the crusher to the road cost $0.438 per cubic yard. Spreading the stone on the road cost $0.066 per cubic yard, and the rolling and sprinkling $0.016 per square yard. The total cost of this improvement, exclusive of grading and preparing the foundation, was $2,092.40, which is at the rate of $0.448 per square yard, or $3,349 per mile. Labor cost $1.80 per day of nine hours, and teams $3.15 per day. Work was begun February 1, 1909, and the road was completed March 31, 1909.

CUMBERLAND GAP, TENN.—The work at Cumberland Gap, Tenn., consisted in building 12,300 feet of macadam road 14 feet wide from Cumberland Gap, Tenn., toward Middlesboro, Ky., besides 900 feet of road which were graded, but not surfaced with stone. Work was begun July 29, 1907, and the road was completed October 9, 1908. On account of the mountainous country an unusual amount of rock excavation was required in order to establish a satisfactory grade, and most unfavorable weather conditions delayed the completion of the road very much. Work was suspended for four months during the winter, in addition to seventy-six days which were lost on account of rain or bad weather. This road is known as the Tri-State road, since it lies partly in the three States—Virginia, Kentucky, and Tennessee.

The earth was excavated with plows and scrapers, and the rock was drilled by hand, blasted, and hauled in wagons to the fills. The old road had a minimum grade of 5 per cent and a maximum grade of 15 per cent. The new road has a minimum grade of 3 per cent and a maximum grade of 10 per cent. In addition to a rock-wall culvert 28 feet long, 173 feet of 12-inch drainpipe were used and 118 feet of 10-inch pipe. The machinery furnished by the Office consisted of four No. 2 wheel scrapers, four No. 2 drag scrapers, one No. 6 plow, one rooter plow, two 2-yard dump wagons, one 450-gallon sprinkler, one 10-ton roller, and one crushing plant with an average capacity of 10 tons per hour. Plows, scrapers, carts, and wagons were furnished by the local authorities as required. The average haul for excavation was 200 feet, and from crusher to road 2,250 feet. The crusher was located at the highest point on the road, at a distance of 500 feet from the quarry, which furnished a very satisfactory grade of limestone. It was necessary to pipe water 900 feet to the crusher, and the average haul of water for the sprinkler and roller was 1,200 feet. The finished macadam surface was made up of a 6-inch foundation course of stone between 1¾ and 3 inches in size, a second course, 2 inches thick, of stone between three-fourths inch and 1¾ inches in size, and a surface course of screenings below three-fourths inch, which was sufficient to fill the voids in the second course. In grading, 22,994 cubic yards of earth and rock were excavated, at a cost of from $0.27 to $0.70 per cubic yard, and for the macadam work 6,380 cubic yards of limestone were quarried at the rate of $0.36 per cubic yard, and crushed at $0.295 per cubic yard. With labor at $1.25 and teams at $3 per day, the total cost of this road, including excavation, macadam, and drainage, was $7,050 per mile, while the cost of the macadam alone was $0.35 per square yard, or $2,875 per mile.

GREENEVILLE, TENN.—The work of improving with macadam a portion of the Newport road leading south from Greeneville was begun on September 16 and the road completed on October 12, 1908. In grading, the earth, which is a very tenacious clay, was loosened mainly by spikes attached to the rear wheels of the road roller. No extensive excavation was required and the earthwork was mainly confined to shaping the roadbed and correcting minor irregularities. The cost of this work was only $0.172 per cubic yard. The stone used was a very hard limestone of good wearing qualities, but of extremely low binding power. This particular difficulty was solved by using for the binder a clay-chert, which is found abundantly in this region. The foundation course was placed loose for a depth of 6 inches and the wearing course for a depth of 5 inches, which, when bonded and compacted, gave 9 inches of finished depth. The section constructed was 700 feet in length, with a total width of 30 feet, of which 14 feet were improved with a macadam surface. The cost of the stone delivered on the road was $1.40 per cubic yard; labor cost $1.25 per day and teams $3 per day. This improvement cost the community $718.46, which is at the rate of $0.66 per square yard, or $5,419 per mile.

Winchester, Tenn.—Work on the construction of a mile of macadam road was begun at Winchester, Tenn., on June 11, 1909. The road is entirely on new location and a considerable amount of earthwork was necessary before it was possible to begin placing the stone. As this road was not completed until after the close of the fiscal year, a detailed report will be given in the next annual report.

Huntington, W. Va.—One-half mile of macadam road was constructed at Huntington, W. Va., between January 13, 1907, when excavation was begun, and August 4, 1908. During this time twenty-three days were lost because of rain and seventeen for lack of material. The road was located on a very steep hillside on heavy grades, which made the construction very difficult. To secure drainage and protect the road against erosion and slides 230 linear feet of 24-inch tile, 334 linear feet of 12-inch tile, 28 linear feet of 10-inch tile, and 270 linear feet of 4-inch drain tile, together with concrete end and retaining walls requiring 60 cubic yards of concrete and 1,200 square feet of riprap, were necessary. About 4,000 cubic yards of excavation, of which 300 cubic yards were rock, were required to secure reasonable grades. A local limestone quarried near the road was used throughout the entire time. The road was built in three courses—a foundation course 6 inches thick, loose, a wearing course 2¼ inches thick, and a bonding course of stone screenings three-fourths inch thick, which compacted into 6½ inches of finished surface. The road was graded 30 feet wide in cuts and 24 feet in fills. The macadam surface was 14 feet wide, except on sharp curves, where it was widened to 20 feet. A total of 536 cubic yards of limestone was quarried by contract at $0.75 per cubic yard and 700 cubic yards were quarried by force account at $0.737 per cubic yard. The cost of hauling the rock to the crusher, a distance of 700 feet, was $0.288 per cubic yard. Hauling the crushed stone to the road, an average distance of 1,700 feet, cost $0.21 per cubic yard. The crushing cost $0.28 per cubic yard, and spreading the broken stone on the road cost $0.054 per cubic yard. The total cost of the road to the community was $5,117.54, of which $566.73 was for drainage and protective works. The cost of this improvement, exclusive of drainage and protective work, was at the rate of $1.07 per square yard, or $9,101 per mile. Labor was paid for at the rate of from $1.25 to $1.50 per day and teams from $3 to $3.50 per day.

GRAVEL ROADS.

Jackson, La.—Between November 24, 1908, and February 25, 1909, 1,320 feet of gravel road, surfaced 12 feet wide and 6 inches thick, were constructed at Jackson, La., in cooperation with the authorities of the state insane asylum. The road was graded 24 feet wide in cuts and 28 feet in fills. The maximum grades were reduced from 5.4 per cent to 1.3 per cent, and this required 1,323 cubic yards of excavation. The gravel was applied in two courses and consolidated with a horse roller. The finished depth of the gravel was 6 inches. Based on asylum labor at $0.35 per day and teams at $3, the improvement cost $818.42, which is at the rate of $3,182 per mile.

Larimore, N. Dak.—Work was begun June 7, 1909, on the construction of a gravel road leading north from Larimore toward McCanna and the road was completed June 18, 1909. The greater portion of the road was over a boggy gumbo soil. To secure proper drainage, 465 cubic yards of excavation, at a cost of $0.202 per cubic yard, were required. In all, 1,320 feet were surfaced 18 feet wide, with gravel to a depth of 8 inches at the center. This required 293 cubic yards of gravel, which was hauled 2¼ miles in farm wagons at a cost of $0.464 per cubic yard. Loading the material at the pit cost $0.092 per cubic yard and spreading it on the roadway $0.014 per cubic yard. The road cost the community $292.10, which is at the rate of $0.11 per square yard, or $1,168 per mile of road surfaced 18 feet wide. Labor cost $1.50 per day and teams $3 per day.

Cheraw, S. C.—The work at Cheraw, S. C., consisted in the construction of a 15-foot gravel road 5,719 feet in length and built by contract according to plans and specifications prepared by this Office. The road extended in a northeasterly direction from the Pee Dee River bridge toward Bennettsville, over low and swampy land, to the higher ground beyond. The gravel was fairly rounded and consisted of pebbles up to 3 inches in diameter, mixed with a red clay, which acted as a binder. The gravel was placed loose to a depth of 10 inches and compacted to a depth of 7½ inches. One vitrified pipe and three reinforced concrete culverts, with spans of 6, 6½, and 10 feet, respectively, were constructed at a cost of $843.94. Screened gravel was used for the concrete and 4-inch I-beams and old rails for reinforcement. The earth excavation amounted to 10,718 cubic yards and cost $1,959.97, or $0.183 per cubic yard. The average haul from the gravel pit to the road was 4,600 feet and the cost of loading and hauling the gravel $0.345 per cubic yard. The contract price for the work was $4,600 and $75 extra was allowed the contractor for additional labor. The royalty paid for the gravel amounted to $130, so that the total cost of the road to the community was $4,805, which, exclusive of the cost of the bridges, is at the rate of $3,655 per mile, or $0.415 per square yard. Labor cost $1 per ten-hour day for men and $3.50 for teams.

Taylor, Tex.—The construction of the gravel road at Taylor, Tex., which was built on gumbo soil, was started on June 10, 1908, and completed on August 21, 1908. The road extends a distance of 3,094 feet, from Fifth street in the direction of Circleville. Sixteeen hundred and one feet were surfaced to a width of 16 feet with 4-foot shoulders, while the remaining distance was surfaced to a width of 22 feet with 2-foot shoulders. The construction of culverts and end walls required materials as follows: Twenty cubic yards of concrete, 135 pounds of reinforcing iron bars, 188 board feet of timber for forms, 188 feet of 12-inch tile, 110 feet of 15-inch tile, 84 feet of 12-inch corrugated steel pipe, and 24 feet of 15-inch corrugated steel pipe. The local authorities furnished a 12-ton steam roller, 11 dump wagons, a 20-horsepower traction engine, a road grader, grading plow, slips, and wheel scrapers. The grade varied from level to 3.68 per cent. At a cost of $0.25 per cubic yard 2,645 cubic yards of earth were excavated, with an average haul of 600 feet. For the surfacing 1,678 cubic yards of flint gravel, containing a large proportion of lime, together with 60 cubic yards of crushed rock, were used. The average haul from gravel pit to road was 5¼ miles, and this unusual distance, which entailed an expense of $1,562.62, greatly increased the cost of construction. A foundation course 5 inches thick, of material under 4 inches in size, was covered with a second course 3 inches thick, of material under 2 inches in size, and thus gave a finished road, after rolling, 7 inches thick. The total cost of the road, including culverts, was $3,626.47, or $6,189 per mile. These figures are based on labor at $1.50 and teams at $3.50 per day, with fuel at $8.27 per ton. The county commissioners have purchased a crushing plant with a view to carrying on the work of road improvement, and they now have at their disposal a complete road-building outfit.

Emporia, Va.—The work on improving 10,732 feet of the river road leading east from Emporia toward Claresville, with a gravel surface 12 feet wide, was begun on August 3, 1908, and the surfacing completed November 11, 1908. No large amount of excavation was necessary, and this item cost only $240.12 for the road graded to a width of 24 feet inside of the ditches. The gravel was hauled in slat-bottom farm wagons, with a capacity of seven-eighths cubic yards, for an average distance from pit to road of about 4,500 feet. This was the largest item of the total cost and amounted to $1,067.73. The gravel was loaded by hand at the pit, and a snatch team was used to help the loaded teams out of the pit. The cost of loading and stripping at the pit was $329.29, while spreading the gravel on the road cost $80.26. Four tile cross drains, with double end walls of brick laid in cement mortar, cost $79.22. The total cost to the community was $2,284.43, which is at the rate of $1,124 per mile; labor cost from $1 to $1.25 per day, while the county teams used are figured only at their cost of keep, or $1 per day.

On September 7, 1908, work was begun on improving a section of the Gaston road leading south from Emporia toward Weldone, and the road was completed November 11, 1908. The right of way was cleared and the road graded to a uniform width of 24 feet for a length of 11,423 feet, of which 10,923 feet were surfaced with a good grade of clay gravel. Approximately 4,000 cubic yards of gravel were required for the surfacing. The average haul from pit to road was one-half mile and cost $0.238 per cubic yard. Loading and stripping at the pit cost $0.085 per cubic yard and spreading the gravel on the road cost $0.018 per cubic yard. Rolling and sprinkling cost $0.026 per cubic yard. The average haul for water for both sprinkler and roller was one-half mile. The cost of seven cross drains with double end walls of brick laid in cement mortar, together with the ditching necessary to secure drainage, was $208.73. Grubbing and clearing the right of way cost $98.72. The grading consisted mainly in opening ditches and raising the roadway sufficiently to provide drainage, and $488.13 was expended for this item. This improvement cost the community $2,626.41, which is at the rate of $1,270 per mile. This is based on labor at $1 to $1.25 per day and county teams without driver at $1 per day.

A gravel and sand-clay road 10,600 feet in length was constructed between October 21, 1908, and January 30, 1909, during which time seventeen and one-half days were lost because of bad weather and for other reasons. The road traversed a rolling and hilly region with a heavy red-clay subsoil. To reduce the maximum grade from 6½ to 4 per cent and secure proper drainage, 2,600 cubic yards of excavation were required, which cost $0.311 per cubic yard. The soil to be excavated was loosened with plows and handled with wheel and slip scrapers, with an average haul of 250 feet. Considerable difficulty was experienced in finding suitable gravel in sufficient quantities, and no less than seven different gravel pits were opened. Three thousand six hundred and forty-eight cubic yards of surfacing material were used, with an average haul of 3,000 feet. The road was graded to a uniform width of 25 feet, of which 14 feet were surfaced for 8 inches deep at the center and 6 inches at the sides. The total cost to the community of this improvement was $3,395.05, of which $633.21 was for bridges and cross drains. Exclusive of bridges and culverts, this improvement was at the rate of $1,315 per mile. The cost of labor varied from $0.75 to $1.50 per day for men and $2 to $3 for teams.

SHELL ROADS.

SOUTHPORT, N. C.—At Southport, N. C., 1 mile of sandy road was graded, and 1,630 feet of it were surfaced to a width of 9 feet with beach shells. The shells were shipped 7 miles by water and hauled an average distance of 4,200 feet in dump carts. A total of 481.2 cubic yards of shells, costing $1.41 per cubic yard when delivered on the road, was used. The shells were spread on the road with shovels and compacted with a horse roller. The work was begun October 19, 1908, and the road was completed March 27, 1909. Much delay was caused by heavy winds, which would cover the shells with sand on the beach where they were secured. The total cost of the improvement was $1,169, which is at the rate of $0.52 per square yard or $2,757 per mile. Efforts to continue the work of road improvement have been very successful and contracts have been let for 6½ miles of additional permanent road improvement.

EARTH ROADS.

JACKSON, LA.—One-half mile of earth road was constructed at Jackson, La., leading east from Jackson. This work was done in cooperation with the authorities of the state hospital for the insane, who supplied the required machinery, labor, and materials. The road was graded 24 feet wide in cuts and 28 feet in fills. A total of 1,270 cubic yards of excavation was required. The maximum grades were reduced from 5.4 per cent to 1.3 per cent. Based on $0.35 per day for men and $3 for teams, the cost of this improvement was $306.75, which is at the rate of $613.50 per mile. Work was begun November 24, 1908, and the road was completed February 27, 1909, during which time thirteen full days were lost because of rain.

MANSFIELD, LA.—Work on the construction of 2 miles of earth road was begun at Mansfield, La., June 16, 1909. Much work was required in clearing the right of way and constructing the necessary bridges. As the work was not completed until after the close of the fiscal year, a detailed report will be given in the next annual report.

PINEVILLE, LA.—At Pineville, La., a 20-foot earth road, 16,200 feet long, was begun March 19, 1909, and completed June 12, 1909, with a loss of eight days on account of bad weather. The work was done partly by convict labor, at a cost of $0.354 per day, and partly by free labor, at $1.25 per day, with teams at $4.25 per day. Plows and picks were used for excavating, and the earth, after being hauled in barrows and wagons, was spread with shovels and with a blade machine. The soil varied from sand to clay and, since the country was hilly, numerous cross drains were required. The grade of old road varied from level to 15 per cent and the improved road from level to 6 per cent. The cross drains and end walls required materials as follows: One hundred and twenty feet of 12-inch, 120 feet of 15-inch, and 90 feet of 18-inch galvanized-iron pipe, 52 feet of 24-inch and 26 feet of 30-inch vitrified tile, 18 barrels of cement, 8 cubic yards of sand, and 18 cubic yards of gravel. A bridge with a span of 51 feet, 18 feet wide, was built of creosoted wood at a cost of $401.49. The work of clearing the right of way, blasting, grubbing, and pulling stumps amounted to $559.07. The total cost of the road to the community, exclusive of bridge and drains, was at the rate of $739.20 per mile.

SCOTTSBLUFF, NEBR.—The improved earth road at Scottsbluff, Nebr., was built through a very hilly country, which required the excavation of 11,464 cubic yards of earth and rock in reducing the maximum grade from 28 per cent to 10 per cent. Excavation was begun May 3, 1909, and the road was completed June 16, 1909, during which time thirteen days were lost on account of bad weather. The earth was loosened with plows and moved with scrapers, but it was necessary to use explosives in removing the rock. The local authorities furnished three plows and nine scrapers. With an average haul of 110 feet, the total cost of excavation was $1,291.15. The construction of three cross drains required 130 feet of 4-foot and 30 feet of 3-foot corrugated steel pipe. The finished road was 11,500 feet long and 20 feet wide, with a crown of 1¼ inches to the foot, and, with labor and teams at $2 and $4 per day, respectively, the total cost of this road to the community was $1,847.65, or at the rate of $850 per mile.

LARIMORE, N. DAK.—Between June 12 and June 20, 1909, 5,700 feet of earth road were constructed on what is known as the Cemetery road, leading north from Larimore toward McCanna. Seven hundred cubic yards of earth were loosened with plows and hauled in wheelers an average distance of 200 feet, at a cost of $0.166 per cubic yard. The width of the roadway was 22 feet inside of the ditches, or a total width of 32 feet in both cut and fill. One cross drain of corrugated iron pipe 18 inches by 24 feet was constructed at a total cost of $37.80. The total cost to the community was $167.85, which is at the rate of $155.48 per mile. Labor cost $1.50 per day and teams $3 per day.

GEARY, OKLA.—One mile of earth road was constructed at Geary, Okla., across a low-lying section subject to overflow. The work consisted in raising the roadway from 2 to 3 feet by moving and elevating a sufficient quantity of earth from the sides and ditches. The earth, which was a heavy, black soil, was loosened by plowing, with a steam plowing engine as power. The grading was all done with a road machine drawn by the plowing engine. In order to get sufficient earth to raise the roadway to the proper height and still leave the bottom of the side ditches at the correct grade, a width of 25 feet on each side of the center line of the road was plowed and whatever amount of earth was needed was moved toward the center. The plowing engine, while a splendid source of power, at the same time served as an excellent roller to compact the earth on the road. The labor and machinery on this work were all donated by neighboring farmers. Had the work been paid for at current wages and current prices for the rent of the machinery, the cost to the community would have been $129.50. This road has proved the beginning for 9 miles of similar road which is now under construction, while the farmers who donated the labor and machinery were so well pleased that they have begun the building of an additional mile of road at their own expense. Work was begun on February 26, 1909, and the road was completed March 6, 1909.

The construction of the improved earth road known as the West road was begun on April 17, 1909, and on May 17, 1909, the work was completed, only one day having been lost on account of bad weather. Over the entire length of 13,200 feet the soil was a sand-clay mixture, so that the work of construction consisted merely in grading and shaping to a width of 22 feet. In reducing the maximum grade from 12.8 per cent to 6 per cent, 5,650 cubic yards of earth were excavated, with an average haul of 250 feet, and the total cost of excavation and shaping was $651.57, or $0.115 per cubic yard. The local authorities furnished one grader, seven drag-scrapers, four wheel-scrapers, two plows, and one road-drag. Two reinforced-concrete bridge culverts were built under contract at a cost of $9 per cubic yard for concrete, while the reinforcing metal was furnished by the county. The total cost of these culverts, which required 50 cubic yards of concrete, was $512.45. With labor at $1.75 and teams at $3.50 per day, the total cost of the West road, exclusive of culverts, was $651.57, or at the rate of $261 per mile.

An improved earth road, known as the North road, was built at Geary between March 30, 1909, and April 16, 1909, during which period no time was lost on account of bad weather. On account of the sandy clay soil, as in the case of the West road at Geary, this work consisted merely in grading and shaping, together with the necessary drainage. The only machinery used was furnished by the local authorities, as follows: Two graders, seven drag-scrapers, four wheel-scrapers, two plows, one 25-horsepower traction engine, and one road-drag. When no fills were necessary, the traction engine was used to draw two graders, and, in making fills, the earth was loosened with plows and moved with drag-scrapers, wheel-scrapers, or wagons, according to the length of the haul, which averaged 300 feet. A total of 5,300 cubic yards of earth was excavated, and the total cost of grading and shaping was $739.61, or at the rate of $0.139 per cubic yard. A total of 22,789 feet was graded to a width of 32 feet in cuts and 24 feet in fills. Two 15-inch corrugated steel pipe culverts, 22 feet long, were built with end walls of rough stone laid in Portland cement mortar, at a total cost of $97.84. Since the cost of labor was $1.75 and of teams $3.50 per day, the total cost of this road, exclusive of culverts, was $739.61, or at the rate of $171 per mile.

WATONGA, OKLA.—On the road leading south from Watonga toward Geary 4,950 feet of earth road were built over a slightly rolling country, which for the greater portion has a heavy clay soil. The road was graded to a uniform width of 24 feet, with a maximum grade of 2 per cent. Nearly 8,000 cubic yards of excavation were required to secure proper grades and drainage. The total cost of this improvement to the community was $1,167.70, which is at the rate of $1,245 per mile. During construction five and one-half days were lost because of rain and bad weather. Labor cost $1.80 per nine-hour day and teams $3.15. Work was begun October 28, 1908, and the road was completed January 23, 1909.

BAY CITY, TEX.—An earth road 15,700 feet in length was constructed at Bay City, Tex., between January 26 and March 3, 1909. The road is through a level section of country with a heavy black gumbo soil. No grading was necessary beyond that required to shape the roadway and provide proper drainage. Because of the level character of the country considerable ditching was necessary to secure good drainage. This was the largest single item in the construction and amounted to $795.77, while the excavation proper amounted to $369.74. Cross drains cost $158.44. These figures are based on labor at $1.50 per day and teams at $4 per day. The cost of the road to the community was $1,457.62, which is at the rate of $490 per mile.

SAND-CLAY ROADS.

TYLER, ALA.—Work on the construction of 4,300 feet of sand-clay road 20 feet wide was begun at Tyler, Ala., on May 4, 1909. Considerable loss of time was caused by rainy weather, and the completion of the road was delayed beyond the close of the fiscal year. A detailed report will therefore be given in the next annual report.

UNION SPRINGS, ALA.—The construction of a sand-clay road at Union Springs was begun February 19, 1909, and the work completed March 8, 1909. The foundation was clay and about 300 feet were improved by mixing sand with the clay on the roadway, while the remaining 1,900 feet were improved with a surface of natural sand-clay mixture 10 inches deep. The natural sand-clay mixture was obtained from pits near the road. The cost of hauling the material to the road was $98; of loading, $73.50; and of spreading it on the road, $16. The entire cost of this improvement to the community was $183.51, which is based on a rate of $1 per day for labor and the same for county teams. The rate per mile for this road was $646, or $0.066 per square yard. Since this work was completed, this county has issued road bonds to the amount of $100,000, and has employed an engineer and begun active work in constructing sand-clay roads.

ATHENS, GA.—The improvement at Athens, Ga., consisted in grading 2,300 feet of road, of which 1,700 feet were surfaced to a width of 16 feet with surface soil from an adjoining farm. The excavation of 2,180 cubic yards of earth and 50 cubic yards of rock was necessary to secure satisfactory grades. One acre of ground from which to secure the surfacing material was purchased at a cost of $25. All work was done with convict labor and county teams, at an actual cost of $414 to the community, and of this amount $234 was for excavation and grading. Work was begun on October 22, 1908, and the road was completed November 18, 1908.

DUBLIN, GA.—Work on the road at Dublin, Ga., was begun December 7, 1908, and completed December 14, 1908, with no time lost because of rain or for other reasons. The road selected for improvement required no grading except such shaping as could be done with the road machine. A length of 3,300 feet was surfaced 20 feet wide. The clay was obtained from nearby pits and contained some sand, so that only a small amount of sand had to be mixed with it on the road. The county convict force was used throughout the time. The average daily cost of maintaining this force, including guards and foreman, was $60. This makes the cost of this improvement to the community $330.15, which is at the rate of $528 per mile, or $0.045 per square yard.

GRIFFIN, GA.—Work was begun on improving 2,000 linear feet of road at Griffin, Ga., 25 feet wide, with a natural sand-clay mixture on November 19, 1908, and was completed two days later. The grading had all been completed during the preceding spring, so that no excavation was found necessary. The surfacing material was a natural mixture of sand, clay, and pebbles found in the vicinity, and in such proportions that no additional material had to be added. Convict labor and county teams were used throughout the work. The cost of this improvement to the community was $70, or at the rate of $185 per mile.

WAYCROSS, GA.—The work at Waycross, Ga., consisted of improving, with a natural sand-clay mixture found near the road, a length of 601 feet of sandy road to a width of 20 feet. As the surfacing material used was a natural sand-clay mixture of the proper proportions, the work of mixing was eliminated. Convict labor was used exclusively. The cost to the community was therefore only the subsistence and guarding of the men and the maintenance of horses and machinery. The cost of the convict labor, including guarding, was $0.40 per day and of single teams, with dump carts, $0.55 per day. The total cost of the improvement was $51.56, which is at the rate of $453 per mile. Work was begun January 26, 1909, and completed February 3, 1909.

WRIGHTSVILLE, GA.—The sand-clay road at Wrightsville, Ga., 3,000 feet long, 16 feet wide and surfaced to a depth of 12 inches, was built altogether by convict labor, with the use of plows, carts, slat-bottom wagons, split-log drags, and such hand implements as could be furnished by the local authorities. Four hundred and forty-four cubic yards of earth were excavated at the rate of $0.124 per cubic yard, and 1,187 cubic yards of the sand-clay surfacing material were required, with an average haul in each case of 1,600 feet. A total of 5,333 square yards was surfaced at a cost to the community of $0.074 per square yard, or $699 per mile. The chief difficulty in this work was the lack of adequate equipment for building a sand-clay road, since there were neither scrapers nor road rollers. This handicap, however, was partially counterbalanced by the energy and interest displayed by the local authorities. It is the intention of the county to obtain proper road-building machinery and continue the work which has been started. Work was begun on March 16, 1909, and the road was entirely completed by April 6, 1909.

CLARKTON, N. C.—Work on clearing and grubbing the right of way for a sand-clay road was begun at Clarkton, N. C., on January 5, 1909, and the road was entirely completed January 30, 1909. This road leads through a fairly level section of country having a top soil of finely powdered sand resting on a sandy-clay subsoil from 1 to 2 feet below the surface. The road was crowned to the proper shape and height, after which enough of the sandy clay was excavated from the side ditches and placed on the roadway to give a compacted sand-clay covering 6 inches deep and 26 feet wide. A total length of 4,000 feet was treated in this manner at a cost of $325.40, which is equivalent to a rate of $430 per mile or $0.028 per square yard of treated road surface. The cost of labor was $0.75 per day and teams cost $3 per day.

FAYETTEVILLE, N. C.—The work of improving with a sand-clay surface the Haymount road leading west from Fayetteville was begun on April 19, 1909, and the road was entirely completed May 21, 1909. The road was built through a hilly region with a sandy loam soil on a clay subsoil at varying depths below the surface. A total of 1,065 cubic yards of clay was used, of which 430 cubic yards were obtained from the side ditches, while the remainder was secured from a pit located 2,100 feet from the road. Three thousand eight hundred and forty feet were improved, 20 feet wide and 10 inches deep, at a cost of $321.14, or at the rate of $441 per mile or $0.038 per square yard. Convict labor was used at a cost of $0.40 per day for men and $1.30 per day for teams.

GREENVILLE, N. C.—The grading for a sand-clay road was begun at Greenville, N. C., on November 16, 1908, and the road was completed December 19, 1908. The surface soil is a fine, smooth sand not suited for road-building purposes. The roadway was graded to a width of 30 feet inside of the ditches, and the entire roadway was then covered with 6 inches of clay to hold down the loose sand. On top of this clay blanket was placed a sand-clay mixture 18 feet wide and 5 inches deep, compacted, and composed of a tenacious clay and and a good coarse pit sand, which was hauled an average distance of 4,500 feet. With labor valued at $1 per day and teams at $3 per day, the cost of the improvement, exclusive of grading, was $305, which is at the rate of $0.04 per square yard or $422 per mile.

GEARY, OKLA.—A sand-clay road, 6,196 feet in length, was constructed at Geary, Okla., between March 1, 1909, and April 8, 1909, during which time five days were lost on account of rain. This road passes through a hilly, sandy region, and the grades were reduced from 8 per cent to 3 per cent, which required 1,900 cubic yards of excavation, at a cost of $0.213 per cubic yard. The road was graded 24 feet wide inside of the ditches, and of this width 15 feet were treated with a sand-clay mixture 10 inches deep. A total of 2,870 cubic yards of clay was required, which was hauled an average distance of 1,500 feet, and cost $0.344 per cubic yard when spread on the road. The total cost to the community was $1,243.60, which is at the rate of $0.075 per square yard or $1,060 per mile. Labor cost $1.75 per day and teams $3.50 per day.

WATONGA, OKLA.—At Watonga, Okla., 6,010 feet of road were surfaced with a sand-clay mixture. For this work 1,305.5 cubic yards of clay were used at the following cost prices: Loading the clay into the wagons, $0.153 per cubic yard; hauling the clay to the road, with an average haul from clay pit to road of 2,410 feet, $0.212 per cubic yard; and spreading the clay on the road, $0.033 per cubic yard. It cost $58.73 to apply the necessary amount of sand to the clay and $33 to mix them properly. The loose material was applied 10 inches deep and 15 feet wide on the roadway. This improvement cost the community $810.24, which is at the rate of $1,119 per mile, or $0.125 per square yard. Labor cost $1.80 per nine-hour day and teams $3.15 per day. Work was begun October 28, 1908, and the road was completed January 23, 1909.

A length of 1,600 feet of sand-clay road was constructed on the road leading south from Watonga toward Geary between December 7 and 12, 1908. Part of this road was very low and wet and the remainder very sandy. The sandy section was improved with a sand-clay surface and the wet section was built up with a sand fill, which was then covered with clay. The material used was a natural sand-clay mixture, part of which was secured from a pit near the road and the remainder from a cut on the road. The average cut on this road was 1 foot and the average fill 2 feet. The maximum grade was reduced from 5 per cent to 3 per cent. The improvement cost the community $429.32, which is at the rate of $1,417 per mile. This is based on labor at $1.80 per nine-hour day and teams at $3.15 per day.

Another piece of work at Watonga consisted of grading 2,560 feet of road, of which 1,400 feet were over very sandy soil. This part was treated with a surfacing of clay, while the remaining 1,260 feet, which were over a heavy gumbo soil, were not treated, but graded and shaped so as to secure proper drainage. Excavation was begun November 16, 1908, and the road was completed December 14, 1908. During this time only one day was lost because of rain or bad weather. This improvement cost the community $563.05, which is equivalent to a rate of $1,165 per mile. The cost of labor was $1.80 per day, and of teams, $3.15 per day.

NEWBERRY, S. C.—Work was begun at Newberry, S. C., on the construction of 5,360 feet of sand-clay road on May 26, 1909, and the road was entirely completed on July 15. No grading was required, since the natural grades were quite satisfactory. The clay was secured from the side ditches, loosened with picks and thrown on the road with shovels. The roadway was 20 feet wide between the ditches and was covered with clay to a depth of 8 inches at the center, with the clay gradually diminishing at the sides. Six inches of sand which was hauled an average distance of 2,000 feet were then spread on the clay and the materials thoroughly mixed. Since this work was not completed within the fiscal year, a detailed statement of it will be made in the next annual report.

Sumter, S. C.—Construction on 5,500 feet of sand-clay road was begun at Sumter, S. C., September 7, 1908, and completed October 14, 1908. This road passes through a very sandy and nearly level region in which great difficulty was experienced in securing clay of suitable quality. The road was surfaced 15 feet wide and 10 inches deep with loose material, which compacted to 7 inches. The amount of clay used was 1,530 cubic yards, which was hauled an average distance of 1,600 feet, while the longest haul was 4,600 feet. The finished roadway was given a crown of 1 inch to the foot. Convict labor was used and proved very satisfactory. Based on the following rates: Foreman, $3 per day; guards, $1 per day; convicts, $0.35 per day; two-horse teams without driver, $0.80 per day, the cost of this improvement to the community was $498.35, which is equivalent to a rate of $0.054 per square yard, or $478 per mile.

Colorado, Tex.—On June 17, 1909, work was begun on a sand-clay and gravel road at Colorado, Tex., and on July 6, 1909, a total length of 2,400 feet had been graded to a width of 60 feet and 2,240 feet had been surfaced to a depth of from 8 to 11 inches with a gravel and sand-clay mixture. All excavation was done with plows and drag scrapers in a soil which varied from sand to a sand-clay mixture. The average haul in the excavation was 200 feet. The average haul from the gravel pit to the road was 1,900 feet and from the clay pit to the road, 1,700 feet, and the materials were loaded into wagons from traps. The local authorities furnished two road plows, six drag scrapers, and one road machine. Seven hundred and seventy-five cubic yards of earth were excavated at a cost of $151.68, and the total cost of this road to the community, based on labor at $1.50 and teams at $4 per day, was $534.08, or at the rate of $1,177 per mile.

Hallville, Tex.—Work on clearing the right of way for a sand-clay road at Hallville, Tex., was begun May 27, 1909, and the road was completed June 11, 1909. A length of 4,400 feet was improved with a sand-clay surface 16 feet wide. The road was graded 28 feet wide in cuts and 30 feet in fills and finished to a uniform width of 24 feet from shoulder to shoulder. The road traversed a rolling country and the soil varied from almost clear sand to heavy clay. To secure proper grades and drainage, 1,800 cubic yards of excavation were required. The earth was loosened with plows and handled with slips and wheel scrapers. The average length of haul for excavation was 380 feet. The clay was applied loose for 6 inches deep and the sand loose for 4 inches deep. The county furnished its own outfit and convict force, which was employed for the entire work. The improvement cost the community $212.46, which is at the rate of $0.027 per square yard, or $255 per mile.

Mineola, Tex.—The improvement at Mineola, Tex., consisted in surfacing with sand and clay a very sandy piece of road 600 feet in length. The work of clearing the right of way was begun May 14, 1909, and the road was entirely completed May 21, 1909. No grading was necessary, except to crown the roadway, which was done with a road machine. The clay was secured from a pit with an average haul of 700 feet. Slat-bottom farm wagons with a capacity of three-fourths of a cubic yard were used for hauling the clay to the road. The road was graded to a uniform width of 25 feet, of which 18 feet were surfaced with the sand-clay. The cost of this improvement to the community was $75.80, which is at the rate of $0.063 per square yard, or $667 per mile.

Nacogdoches, Tex.—Work on improving with a sand-clay surface a section of the San Antonio road leading east from Nacogdoches toward Melrose was begun August 28, 1908, and completed November 17, 1908. The road traversed a rolling country, and 5,916 cubic yards of excavation were required. The soil varied from a deep, fine sand to a sandy clay. The soil to be excavated was loosened with plows and handled with slip scrapers, wheel scrapers, and wagons, according to the length of haul, at an average cost of $0.103 per cubic yard. A length of 13,010 feet was graded, of which 10,890 feet were surfaced with sand-clay from 15 to 18 feet wide and 5½ inches deep. This required 2,477 cubic yards of material, which was hauled an average distance of 600 feet at a cost of $0.146 per cubic yard. Loading the surfacing material at the pit cost $0.024 per cubic yard, and mixing the material on the road cost $0.0024 per square yard. This improvement cost the community $1,604.10, which is at the rate of $654 per mile, or $0.073 per square yard. Labor cost, $1 per day for free labor, 50 cents for convicts, and $2 for teams without a driver. As a result of this improvement public interest in better roads has been aroused and considerable further work is now in progress.

Paris, Tex.—A length of 3,716 feet of sand-clay road, surfaced to a width of 18 feet, was constructed at Paris, Tex., between December 17, 1908, and January 22, 1909. Considerable fill was required for bringing the road to the proper grade. About 465 cubic yards of this required a haul of 2,200 feet, which made the average cost of fill in place $0.286 per cubic yard. The surfacing material was hauled in slat-bottom wagons with a capacity of 1 cubic yard for an average distance of five-eighths of a mile at $0.248 per cubic yard. The cost of loading surfacing material was $0.10 and of spreading it $0.051, per cubic yard. The loose material was placed 8 inches deep at the center and 6 inches deep at the sides. After thorough mixing and rolling, this compacted to 6 and 4½ inches. A total of 1,445 cubic yards of surfacing material was used. Based on labor at $1.50 per day and teams at $3, the cost of the improvement was $1,120.67, of which $64.56 was for cross drains. This is at the rate of $0.14 per square yard or $1,474 per mile.

Terrell, Tex.—Work on the Country Club road leading northwest from Terrell toward Royse was begun March 30, 1909, and the road was completed April 12, 1909. One mile of road was graded to a width of 32 feet, of which 18 feet were improved with a sand-clay surface 8 inches thick. This work required 2,550 cubic yards of excavation with an average haul of 675 feet at a cost of $0.226 per cubic yard. A total of 1,155 cubic yards of clay was used, at a cost of $0.211 per cubic yard when delivered on the road. Labor was paid for at the rate of $1.50 per day for men and $3 for teams. The improvement cost the community $534.15, which is equivalent to $0.05 per square yard. In addition, one reinforced concrete bridge was erected at a cost of $369.65.

A sand-clay road 7,900 feet in length leading southwest from Terrell toward Salty was begun on March 16, 1909, and completed April 12, 1909. The roadway was graded from 25 to 30 feet wide and 18 feet were surfaced with sand-clay 8 inches thick. The road was crowned from three-fourths of an inch to 1 inch per foot. The earth excavation amounted to 2,635 cubic yards, and the work was done with slip scrapers and wagons at a cost of $0.073 per cubic yard. Two thousand three hundred and sixty cubic yards of clay were used, with an average haul of 1,100 feet. The cost of hauling the clay was $0.085 per cubic yard, and loosening and loading it cost $0.061 per cubic yard. Slat-bottom farm wagons with a capacity of 1 cubic yard were used. The cost of the road to the community was $794.36, of which $128.53 was for four vitrified tile cross drains with end walls of brick laid in cement mortar. Labor cost $1.50 per day and teams $3.

Troupe, Tex.—Excavation preparatory to building a sand-clay road was begun at Troupe, Tex., December 11, 1908, and the road was completed January 17, 1909, during which time seven days were lost on account of rain and bad weather. The road was through a rolling country with a heavy clay soil. A length of 2,600 feet was graded, of which 2,000 feet were surfaced with sand-clay 15 feet wide and 4 to 8 inches deep. The maximum grades were reduced from 10 to 4 per cent, which required 1,000 cubic yards of excavation at a cost of $0.096 per cubic yard. As the road was all in heavy clay, no clay was hauled for surfacing. The 400 cubic yards of sand required were secured at a pit 1½ miles from the road. The hauling was done in slat-bottom farm wagons with a capacity of 1 cubic yard, at a cost of $0.407 per cubic yard. The total cost to the community was $334, which is at the rate of $0.073 per square yard, or $664 per mile. Labor cost $1 per day for men and $2.50 for teams.

Tyler, Tex.—Work on the road leading east from Tyler toward Browning was begun October 26, 1908, and completed November 10, 1908. One-half mile was improved with a sand-clay surface 15 feet wide and 5½ inches thick. This road passes through a rolling section of country, with the soil varying from clay to deep sand, and about 1,070 cubic yards of excavation were required to secure reasonable grades and good drainage. Wheel scrapers could not be had, and the greater portion of the excavation was handled in slat-bottom farm wagons, with a maximum haul of 500 feet, at a cost of $0.105 per cubic yard. The surfacing material was hauled in wagons a distance of 1,400 feet, at a cost of $0.205 per cubic yard. The cost of loading the material was $0.0257 per cubic yard; of spreading it on the road, $0.0186 per cubic yard; and of mixing the materials on the road, $0.015 per cubic yard. This improvement cost the community $381.58, which is at the rate of $0.088 per square yard, or $763 per mile. Labor cost $1 per day for men and $3 for teams.

A portion of the Tyler-Chandler road leading west from Tyler was improved with a sand-clay surface. The road passes through a rolling section of country, where the soil varies from clay to almost pure sand. A length of 2,740 feet was graded, of which 2,100 feet were surfaced with sand-clay 15 feet wide and 5½ inches thick. The old roadway was worn very deep and narrow in many places, and this made the cost of excavation high, since hand labor had to be resorted to very largely. Four hundred and seventy cubic yards were handled at a cost of $0.404 per cubic yard, and 730 cubic yards of sand and clay were used for surfacing. The cost of loading surfacing material was $0.111 per cubic yard; of hauling from pit to road, $0.251 per cubic yard; of spreading on the road, $0.024 per cubic yard; of mixing the sand and clay on the road, $0.0032 per square yard; and of rolling, $0.0023 per square yard. The cost of this road to the community was $570.69, which is at the rate of $0.125 per square yard, or $1,100 per mile. Work was begun November 12, 1908, and the road was completed December 12, 1908. Labor was paid for at the rate of $1 per day for men and $3 for teams.

EXPERIMENTAL ROADS.[a]

SAND-CLAY ROADS.—*Waterloo, Iowa.*—The construction of the sand-clay road at Waterloo, Iowa, was begun August 7, 1908, and on August 14, 2,200 feet had been graded and shaped to a width of 32 feet, and 1,610 feet had been surfaced with a sand-clay mixture to a finished depth of 9 inches, leaving 590 feet to be completed by the state highway commission. Two hundred and sixty cubic yards of earth were excavated and loaded with an elevating grader, which was furnished to the community for this demonstration by a manufacturing company. The country was slightly rolling, and the soil was a fine sand or sandy loam over the entire length of section improved. The average haul for excavation was 300 feet and for the sand-clay surfacing material, 2,933 feet. In spreading this material, a two-horse grader was used to very great advantage, at a cost of $0.02 per cubic yard. The total cost of this road to the community was $0.183 per square yard, or at the rate of $2,202 per mile, with labor valued at $3 and teams at $5 per day. The high price of labor and short working day, together with the unusual width of road, accounts for the apparently high cost of this work.

Bucklin, Kans.—The construction of a sand-clay road at Bucklin, Kans., consisted in grading a stretch of 3,155 feet to a width of 30 feet, and surfacing a length of 4,275 feet to a width of 14 feet, with a crown of three-fourths inch to the foot. The work of grading was begun November 24, 1908, and on December 23, 1908, the road was completed, with only three days lost on account of bad weather. Since the soil was sandy over the entire length of road, no drains were required. Excavation amounting to 1,584 cubic yards was made with plows and moved with scrapers at a cost of $0.14 per cubic yard for an average haul of 276 feet. Eighteen hundred and eighty-three cubic yards of clay were used for surfacing, with an average haul from pit to road of 1,619 feet. This material was spread by hand and with a two-horse grader to a depth of from 10 to 13 inches, and was followed by a 1-inch course of sand, giving a finished depth to the road of 10 inches after being compacted. The total cost of this work, computed on the basis of labor at $2 and teams at $3 per day, was $958.36, which is equivalent to $1,184 per mile.

Dodge City, Kans.—Work on the sand-clay road at Dodge City, Kans., was started October 26 and completed December 10, 1908, with ten and one-half days lost on account of bad weather. The improved section, which is 9,750 feet long and is surfaced to a width of 14 feet, was built on sandy soil through a rolling country. At the south end the soil becomes hard by reason of the gypsum clay in it. A change of grade at the south end made it necessary to raise a pile bridge at that point 4 feet. This bridge has a 25-foot span and carries a 16-foot roadway. Piles were driven and boarded up for wing walls at this bridge, but concrete would have been used had sufficient funds been available. The local machinery used on this road consisted of graders for spreading material and dressing the road, wheel and slip scrapers for grading, ordinary plows for loosening the earth, and farm wagons for hauling clay. Twenty-five hundred and thirty-nine cubic yards of earth were excavated at a cost of $0.153 per cubic card, with an average haul of 234 feet, and 3,703 cubic yards of a gumbo clay sediment from the Arkansas River were used for surfacing, with an average haul from pit to road in this case of 2,091 feet. This material was dropped on the road in three parallel rows and spread by hand and with a two-horse grader to a depth of 10 inches. When this clay had been covered with a course of sand, the whole gave a finished road about 10 inches thick. Figuring labor at $2 and teams at $3 per day, the total cost of this work, exclusive of grading and bridge work, was $1,641.19, or at the rate of $889 per mile.

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[a] Circular 90 of this Office contains a complete description of the experiments made on these roads at Birmingham, Ala.; Bucklin, Kans.; Ford, Kans.; Garden City, Kans.; Independence, Kans.; and Newton, Mass.

Ford, Kans.—At Ford, Kans., a short section forming the southern approach to the bridge crossing the Arkansas River was graded and clay was added. The natural roadbed was sand, and the clay was secured from a valley basin, where it had settled as river silt. The section improved was 350 feet long, and it was covered with 12 inches of clay to a width of 16 feet. Two inches of sand were then added to the surface and left for traffic to mix, because the clay was frozen when placed on the road. The total cost to the community was $104.25, distributed in part as follows: Preparing the roadbed, $17.25; plowing and hauling the clay, $10.50; spreading the clay, $8; placing the sand on the road, $8; and dressing the road with a grader, $0.50.

Garden City, Kans.—A sand-clay object-lesson road 765 feet long and 12 feet wide, with a crown of three-fourths of an inch to the foot, was built at Garden City between October 12 and October 20, 1908, with no loss of time from any cause. No grading was necessary and, since the cross-section of the existing sandy road was satisfactory, the work consisted in spreading gypsum clay to a depth of 9 inches and throwing up a 6-foot sand shoulder on each side with plows. A drag was used to finish the road and, when the clay was wet, it was covered with a 1-inch course of sand. Two hundred and fifty-six cubic yards of clay were used for surfacing, with an average haul from pit to road of 459 feet. The total cost of this road to the community, based on labor at $2 and teams at $3 per day, was $102.50, or at the rate of $707 per mile. Since these gypsum clay deposits are widely scattered over this territory, it is thought that, by pursuing the sand-clay method of construction, the roads in this section can be very much improved at a reasonable cost.

Fairbury, Nebr.—Grading on the cemetery road leading east from Fairbury toward Diller was begun April 29, 1909, and the road was completed May 20, 1909. This road leads through a level section of country, where the soil varies from sand to black gumbo. The excavation of 1,109 cubic yards of earth, at a cost of $0.26 per cubic yard, was required to secure the proper grade and drainage. One 12-inch vitrified-clay tile cross drain with concrete end walls was constructed. The surfacing material was a natural gravel-sand-clay mixture found in pits in close proximity to the road. The section improved was 2,311 feet in length, and it was surfaced to a width of 15 feet, and a depth of 6 inches when compacted. The total cost of the road to the community was $494.78, which is equivalent to $1,060 per mile, or $0.123 per square yard. The cost of labor was $2 per day, with $3.50 per day for teams.

Ravenna, Nebr.—The sand-clay road at Ravenna, Nebr., was built over a gently rolling country by mixing a surface course of clay with the natural sand foundation. Work was started on May 27, 1909, and completed on June 24, 1909, with a loss of three and one-half days on account of bad weather. On account of a lack of funds, the general topography of the country was followed without making any material changes in the grade, which varies in the improved road from 0.37 per cent to 5 per cent. The machinery furnished by the local authorities consisted of one road machine, two plows, two harrows, one split-log drag, and slip scrapers as required. Four hundred and forty-eight cubic yards of earth were excavated at a cost of $0.205 per cubic yard, with an average haul of 250 feet, and 615 cubic yards of clay were used for surfacing, with an average haul of 2 miles. The pit from which this clay was taken was the only accessible one containing a satisfactory material, but, on account of the excessive haul the cost of building, this road was very much greater than it would have been under more favorable conditions. A total length of 3,448 feet was graded to a width of 26 feet, and 2,368 feet were surfaced to a width of 12 feet, with a crown of three-fourths of an inch to the foot. With labor at $1.75, and teams with drivers at $3.50 per day, the total cost of this road to the community was at the rate of $1,460 per mile.

Stuart, Nebr.—The work at Stuart, Nebr., consisted in surfacing with sand clay 4,520 feet of road 18 feet wide over gumbo and black prairie soil. Work was begun on June 29, 1909, but as the road was not completed by the end of the fiscal year, a full report will be given in the next annual report.

BURNT-CLAY ROADS.—*Tallulah, La.*—The burnt-clay road at Tallulah, La., was started April 30, 1908, and completed August 29, 1908, during which time twenty-two days were lost on account of bad weather. A stretch of 1,312 feet was surfaced with burnt clay to a width of 14 feet, with 6-foot finished shoulders, giving a 26-foot finished roadway. In addition to this, 1,430 feet of earth road were built without being surfaced. A total of 3,051 cubic yards of earth was excavated at a cost of $846.48. The adjacent country was level, and the clay, which is known as "buckshot gumbo," was burned in 307 flues, 4 feet wide, extending across the road. This burning required 194 cords of wood, 6 barrels of refined oil, and 54 gallons of crude oil. The cost of the burnt-clay road was $1,475.21, or $5,937 per mile, and the cost of the earth road was $850.25, or $3,139 per mile. The above figures are based on labor at $1.50, teams without driver at $2 per day, and fuel wood at $2.25 per cord when delivered. An unusually rainy period of several weeks just before the work began made the excavation very difficult and added greatly to its cost. It is estimated that under favorable conditions the cost would be reduced 50 per cent.

ROADS WITH OIL, TAR, OR ASPHALT BINDERS.—*Birmingham, Ala.*—Five experimental sections consisting of tar-slag, tarred slag, and tarred slag-limestone were made on the Duck Pond road leading from Birmingham to Ensley. In these experiments the old road was entirely reconstructed and a 24-foot tar-treated macadam with 5-foot shoulders was built on grades of less than 5 per cent. The materials employed were blast-furnace slag, limestone, and tar. The slag, which was hard, glassy, and acidic, was produced at the neighboring town of Bessemer. The limestone was shipped 40 miles by rail, while the tar was obtained from by-product coke ovens and was produced at a low temperature. In all, 12,000 square yards were constructed at a cost of $13,251.05, which includes the cost of excavation and necessary drains.

Manteca, Cal.—The work at Manteca, Cal., consisted of treating 450 feet of very sandy road with a heavy asphaltic oil, while 550 feet were surfaced with stone, in which the voids were filled with sand and then bonded with oil. The oil used contained 77 per cent asphaltum, 0.8 per cent water, and 0.8 per cent sediment. Its gravity was 12.6° Baumé, and it cost $0.95 per barrel f. o. b. at Ripon. In all 149.2 barrels were used. The stone cost $1.35 per ton f. o. b. at Manteca and 81 tons were used. On the sand section 2.3 gallons of oil per square yard were used, while the stone section required 3.6 gallons per square yard. The total cost to the community was $457.78. The rock-surfaced portion cost $0.391 per square yard, while the oiled sand portion cost $0.153 per square yard. Labor cost from $2 to $2.50 per day and teams from $4.75 to $5 per eight-hour day.

Independence, Kans.—The experiment at Independence, Kans., consisted in treating two sections of earth streets with a locally produced artificial asphalt. For a length of about 300 feet the soil on one street was a heavy slate-colored gumbo, and considerable difficulty was experienced in thoroughly incorporating the asphaltic preparation with the soil. The remaining 500 feet were buckshot clay, which pulverized fairly well and were not as difficult to treat. The soil of the second street was composed mainly of disintegrated shale and argillaceous sandstone. The road was plowed to a depth of 6 inches and pulverized with a disk harrow and plank drag. The asphaltic preparation was then applied at a temperature of about 350° F. Several methods of mixing the earth and asphalt were tried. The most satisfactory proved to be by moving the earth and asphalt back and forth across the road with a road grader. In this experiment 5,218 square yards were treated at a cost of $1,474.15, or at the rate of $0.2825 per square yard, exclusive of grading.

Eminence, Ky.—The work at Eminence, Ky., consisted in the construction of a 12-foot limestone macadam road with an oiled surface. A length of 4,070 feet on the Shelbyville road leading south from Eminence was improved in this manner. Work on the excavation for the necessary side drains was begun March 2, 1908, and the road was entirely completed July 13, 1908, during which time thirty days were lost on account of rain and bad weather. The grade of the old road was satisfactory, so that only a small amount of excavation was found necessary. The road was built on a clay foundation, which required for underdrainage 75 feet of 4-inch, 301 feet of 5-inch, 644 feet of 6-inch, and 75 feet of 8-inch drain tile, which cost, installed, $101.69, while five cross drains were constructed at a cost of $140.74. A fair grade of limestone was secured at a local quarry 2 miles from the road. The crushed stone was delivered on the road by contract at $1 per cubic yard. The stone was laid in three courses to a depth of 9½ inches, loose, which, when finished, was rolled down to 6½ inches. The surface was then sprinkled with a crude Ragland oil which cost $0.05 per gallon. A short section was coated with tarvia, which cost $0.07 per gallon. In all, 1,250 gallons of crude oil and 250 gallons of tarvia were used. The cost of applying these coatings was $8, making the total cost of the surface treatment $88, or $0.016 per square yard. The road cost the community $2,277.29, which is at the rate of $0.42 per square yard, or $2,957 per mile. Labor cost $1 per day and teams $3.

Newton, Mass.—The experiments at Newton, Mass., were conducted by this Office in cooperation with Mr. Charles W. Ross, street commissioner of Newton. Sections of Cabot and Summit streets were selected for surfacing. Eleven different experiments were made in the use of asphaltic preparations, tar preparations, residual oil, and a molasses-lime-oil mixture as binders. The total area treated was 5,909 square yards, at a cost for labor and materials of $2,714.61.

El Paso, Tex.—Work on resurfacing 5 miles of old macadam road at this place with an asphalt macadam was begun May 10, 1909. The dust was first swept off with wire brooms and the roadway spiked up with a road roller. The road was then shaped and given a crown of one-half inch to the foot, after which a layer of 1½ inches of clean limestone was added and thoroughly rolled. The voids were then filled with stone chips from one-fourth to one-half inch in size, which were thrown over the surface and swept into the voids of the 1½-inch stone. Without further rolling and without the use of any water, about 15 pounds per square yard of asphalt heated to about 300° F. were sprinkled over the surface. After the asphalt had been applied, stone screenings were spread over the road and rolled until the road was thoroughly consolidated. This work was not completed at the close of the fiscal year and will be fully described in the next annual report.

INSTRUCTION IN HIGHWAY ENGINEERING.

Under this project graduate engineers are appointed after a competitive civil service examination to the position of civil engineer student at a salary of $60 per month and field expenses. It is realized that the average graduate from an engineering school does not possess the practical knowledge of road building such as would enable him to take up this work immediately upon graduation. It is, therefore, the policy of this Office to give the student during a period of one year thorough training in all branches of highway work both in the field and in the laboratory, during which period his services are fully utilized by the Office in furthering its general work. At the end of this time, if the student has proved his worth to the Office and it is found that the needs of the service justify it, he is retained as a junior highway engineer. At the end of the second year he is eligible for further promotion to the grade of highway engineer, and eventually to the position of senior highway engineer, although no fixed practice has been adopted governing the length of time during which he shall remain in each grade.

The practical instruction and experience which the student obtains in the routine work of the Office is supplemented by a course of theoretical instruction covering a period of eight weeks given during the months of January and February, when field work is at a minimum. This instruction covers the preparation of themes and the study of problems in road construction and in the testing laboratories, including microscopic work and chemical analysis, a study of dust preventives, plotting, field notes, estimates, study and research in road legislation, administration and history, general geology, quarrying, selection of road materials, and special studies of clays, asphalts, bitumens, and cements.

Six engineer students were appointed for service during the last fiscal year, five of whom have remained in the service. This project has given excellent results, and the engineers, after a few years' training with this Office, are in great demand for state and county work. It is a gratifying development that state and county officials are turning more and more to the Office for engineers to carry out their road work. This practice is, of course, injurious, in one sense, to the efficiency of the Office in that our best men are constantly leaving us, but the result in gain through the distribution of trained men in all sections of the country is so great as to be a vindication of the wisdom of the project.

The investigation with regard to the status of highway engineering in schools and colleges has been supplemented by much cooperative work, tending to the improvement of the courses of construction in highway engineering. The Office has aided a number of schools in establishing first-class testing laboratories and has given advice in connection with the course of study.

LECTURES, ADDRESSES, AND PAPERS.

The lecture work of the Office covers a wide field, ranging from those of an elementary character given before rural organizations to the highly technical papers read before scientific bodies. All of the representatives of the Office engaged in this project, however, are required to confine themselves to the practical phases of the subject and to keep strictly within the bounds of conservatism. It is the policy of the Office to conduct propaganda work to the extent of arousing public sentiment in support of united reforms in the methods of administration and in the construction and maintenance of roads, but to urge caution and conservatism, in order to avoid a lavish waste of road revenues in the establishment of costly systems and the building of roads unsuited to the needs and means of the interested locality. There were in all 185 lectures given.

SPECIAL INSPECTION AND ADVICE.

Under this project is included the general advisory work of the Office not otherwise assigned. There are many problems arising in connection with the various branches of road work which can be solved only after inspection and advice by the engineers of this Office. The following representative examples will give some idea of the varied nature of these assignments: Inspection of a proposed earth road and estimate of cost of the same; inspection of county roads and conditions, and advice regarding the same; advice on the improvement of the county survey by the Forest Service; inspection of a rural route, advice to the postmaster, and demonstration of the split-log drag; advice regarding the testing and use of bituminous materials; advice regarding road and bridge improvements and the most advantageous use of available funds; and advice concerning the building of sand-clay, earth, gravel, macadam, etc., roads. The total number of such assignments during the past year was 142, and a list of the different assignments is given by States as follows:

ALABAMA.—Huntsville, July 31 and August 1, 1908; Jasper, April 7–10, 1909; Fayette, April 12–14, 1909; Birmingham, April 15–16, 1909; Tuscaloosa, April 17–19, 1909; Eutaw, April 21–24, 1909; Greensboro, April 26–29, 1909; Dallas County, during the month of May, 1909; Wetumpka, June 15–16, 1909.

ARKANSAS.—Hot Springs, July 9–22, 1908; Conway, July 23–31, 1908; Brinkley, August 2–7, 1908.

CALIFORNIA.—San Diego, December 4–31, 1908, and January 1–26, 1909; Napa, January 9–19, 1909; Hemet, March 7–10, 1909; Banning, April 7–8, 1909; Palm Springs, April 8–10, 1909; Riverside, May 19–22, 1909.

COLORADO.—Boulder, November 18–25, 1908; Grand Junction, June 28 to July 4, 1909.

DELAWARE.—Wilmington, April 7–8, 1909.

GEORGIA.—Gainesville, October 21–27, 1909.

IDAHO.—Wallace, August 22 to September 30, 1908; Moscow, September 22, 1908.

ILLINOIS.—Chicago, August 17–23 and 25–26, 1908, October 22 to November 11, 1908; Springfield, June 18–21, 1909; Dwight, Naperville, and Chicago, June 22–23, 1909.

IOWA.—Ames, September 3–5, 1908.

INDIANA.—Charlestown, October 3, 1908; Lakeville, June 26 and 27, 1909.

KANSAS.—Englewood, July 1–8, 1908; Ashland, December 24–26, 1908; Fredonia, December 27–31, 1908.

KENTUCKY.—Clinton, July 21–22, 1908; Bowling Green, January 3–5, 1909.

LOUISIANA.—Tallulah, November 3, 1908; Boyce, May 8–9, 1909; Morgan City, May 17–19, 1909; Bunkie, June 13, 1909; New Orleans, June 19, 1909; Baton Rouge, June 22, 1909.

MARYLAND.—Seneca, July 6–7, 1908; Somerset, August 4, 1908; Edson, March 12 and April 6, 1909; Washington Grove, May 6, 1909.

MASSACHUSETTS.—Newton, July 1–7 and 17–22 and September 24 and 29, 1908.

MINNESOTA.—Cass Lake, July 24 to August 21, 1908.

MISSISSIPPI.—Aberdeen, August 8–17, 1908; Greenville, October 31 and November 2, 1908.

MONTANA.—Bozeman, September 10–11, 1908; Butte, September 12–15, 1908.

NEBRASKA.—Sargent, July 9–14, 1908; North Platte, July 15–20, 1908; Morrill, July 21–23, 1908; Tecumseh, July 25–29, 1908; Scottsbluff, November 28, 1908; Ravenna, December 5–8, 1908; York, December 8–9, 1908; Harrisburg, December 10–22, 1908; Scotts Bluff and Banner counties, May 17–20 and 25–29, and June 21–30, 1909.

NEVADA.—Fallon, January 21–27, 1909; Hazen, January 27–31, 1909.

NEW MEXICO.—Capitan, March 26–April 18, 1909; Albuquerque, April 19–20, 1909; Alamogordo, April 21–30 and May 23 to June 15, 1909.

NORTH CAROLINA.—Newbern, July 27–31, 1908; Alamance County, September 3–5 and 10, and October 3 and 5, 1908; Greenville, October 5–7 and 14–16, 1908; Southport, October 19, 1908; Black Mountain, November 1–16, 1908; Burlington, January 28–29, 1909; Oxford and Weldon, March 20 to April 3, 1909.

NORTH DAKOTA.—Bismarck, April 23 to May 12, 1909.

OHIO.—Monclova, October 4, 1908; Holland, October 5, 1908; Toledo, October 6–7, 1908; Youngstown, June 24, 1909; Bryan, June 28–30, 1909.

OKLAHOMA.—Meridian, November 25–26, 1908; Watonga, December 26–27, 1908; Guthrie, December 28, 1908; Carnegie, December 29–31, 1908; Guthrie, February 5–7, 1909; Woodward, February 8–11, 1909; Geary, February 12–13, 1909; Cordell, March 16–18, 1909; Watonga, May 26 to June 15, 1909; Chandler, June 24–30, 1909.

OREGON.—Portland, May 23–31, 1909; Medford, June 1–12, 1909; Klamath Falls, June 13–20, 1909; Portland, June 20–30, 1909.

SOUTH CAROLINA.—Newberry, August 23–29, 1908; Johnston, January 23, 1909; Saluda, January 23 and February 4 to 13, 1909.

SOUTH DAKOTA.—Canton, September 6–7, 1908.

TENNESSEE.—Greeneville, January 21–24, 1909; Johnson City, April 27, 1909; Bristol, May 16–24, 1909.

TEXAS.—El Paso, October 31 to November 4, 1908; Paris, November 25–26, 1908; Pittsburg, December, 1908; Blessing, March 9, 1909; Bay City, March 12, 1909; Sherman, April 8–14, 1909; Denison, April 15, 1909.

VIRGINIA.—Blacksburg, August 23–26, 1908; Charlottesville, December 16, 1908; Trevilians, April 8, 1909; Waverly, April 9, 1909; Wakefield, April 10, 1909; Smithfield, April 11, 1909; Suffolk, April 12, 1909; Tasley, April 13, 1909; Williamsburg, April 14, 1909; Mathews Court House, April 15, 1909; Whitestone, April 16, 1909; Westland, April 17, 1909; Lancaster, April 18, 1909; Warsaw, April 19, 1909; Tappahannock, April 20, 1909, and Montross, April 21, 1909.

WASHINGTON.—Pullman, September 19–21, 1909.

INVESTIGATIONS OF ROAD MATERIALS IN THE SEVERAL STATES.

The investigations of road materials in the several States, begun in cooperation with the Geological Survey during the fiscal year 1908, have been continued and their scope somewhat broadened. In addition to the bulletin issued descriptive of the road materials of Maine, a second bulletin was prepared under this project by the state highway commissioner of Minnesota on the subject of road materials in Minnesota. It is proposed to continue this work until complete information is available relating to the road materials of all the States.

MODEL SYSTEMS OF ROAD CONSTRUCTION, MAINTENANCE, AND ADMINISTRATION.

This project has been considerably enlarged during the past year and provides for the assignment of engineers to make complete investigations of roads, available materials, methods of construction, maintenance, and administration in the various counties to which they may be assigned. They are also instructed to prepare complete reports, giving all data of value in connection with the road systems under investigation, with recommendations and detailed plans and estimates for the future road work of the county, covering a period of several years. During the past fiscal year Morgan County, Ala., San Joaquin, Fresno, and San Diego counties, Cal., and Matagorda County, Tex., have received assistance under this project. Much data and information of great value, not only to the respective counties, but to engineers, road officials, and the people of the country in general, has been gathered.

Comprehensive reports containing data on the classification of roads, systems of administration, revenues, methods of construction, road materials, and other subjects relative to road improvements in the widest sense have been made by the engineers assigned to this work, and the information has been given to the respective counties as well as placed on file in this Office. As an example of this work, San Joaquin County, Cal., may be mentioned. At the request of the proper authorities an engineer was detailed to make a comprehensive study of all conditions affecting the highways of that county. About three months were required for this work, during which time his salary was paid by the Government and his local expenses by the community. The final report, besides containing a full and detailed description of the existing conditions, embodied also detailed recommendations for a system of improvements in road administration, construction, and maintenance within the reach of the people and which they have since adopted. A bond issue of about $1,800,000 was voted to provide the necessary revenues, and a system of roads is now under construction which will place San Joaquin County among the foremost counties of the State in the matter of transportation facilities.

INVESTIGATION OF DUST PREVENTIVES AND ROAD PRESERVATIVES.

No road problems are at the present time attracting more general attention than those of dust prevention and road preservation. Letters are received daily asking for advice relative to the characteristics and use of the dust preventives and the road binders best suited to meet the requirements of roads subjected to various local conditions. During the past year the Office has been actively engaged in investigations of such materials, both in the laboratory and in the field, and considerable progress has been made along both lines.

Methods of analysis and examination of the different classes of bituminous road materials have been developed and perfected, and some of these methods have already been recommended for adoption by technical societies interested in the testing of these materials. The great necessity for standardizing such methods has led the Office to cooperate with these societies as far as possible, and it has taken part in both written and oral discussions relative to the adoption of such tests.

A laboratory investigation of the effect of free carbon in tars from the standpoint of road treatment has been carried out and the results published. A machine for determining the binding value of bituminous materials has also been developed and a working model of this machine is now in process of construction.

Field experiments with tar, oil, and asphalt binders in road construction have been carried on in the States of Massachusetts, Alabama, and Kansas. A waste molasses-oil-lime mixture originated by the Office has been successfully employed as a road binder in Massachusetts, and a number of experiments in the treatment of old road surfaces with waste sulphite liquors obtained from wood-pulp manufactories have been made with promising results in the District of Columbia. Most of these experiments have been published in the form of progress reports and the remainder will be published in the next reports of this nature issued. It is the policy of the Office as far as possible to encourage the use of local waste or by-products in the treatment of roads, and the proper preparation and utilization of such materials is a subject which has been given considerable attention.

INVESTIGATION OF SLAG AS A ROAD MATERIAL.

The work carried on in the petrographic laboratory for the fiscal year embraced, besides the usual routine examination and analysis of rocks for road making, an extensive study of blast-furnace and open-hearth slag to determine their road-making qualities. A large number of slag samples were analyzed both chemically and microscopically and tested in regard to their physical properties. The results of this investigation led to a logical classification of slags, both from the converter and blast furnaces, and established certain definite relations between the mineral composition and physical properties which have proved to be of considerable practical value in determining the road-making qualities of this class of material.

Laboratory tests and experience in the field have demonstrated that only certain varieties of slag, consisting essentially of silicate minerals readily decomposed by water, are of value as road material, and that the binding properties of these slags may be in many cases greatly increased by the addition of quicklime or calcic hydrate.

A quick method has been devised for estimating the solubility and consequently the cementing value of slags in the field, by means of phenolphthalein indicator, which has proved satisfactory.

In the following year the slag investigations will be continued in conjunction with the ordinary routine work of the laboratory, with a view to determining more exactly the nature of the secondary products formed in the slag after treatment with water, so that the present methods of slag road construction may, if necessary, be modified.

ROUTINE TESTS OF ROAD MATERIALS.

Complete laboratories are maintained by the Office for the purpose of determining the mineral composition of road materials by microscopic and chemical analyses, and a physical laboratory to determine their physical qualities, such as hardness, toughness, cementing value, resistance to wear, water absorption, and specific gravity. These tests are made free of cost for any citizen of the United States, provided the samples are submitted in accordance with certain forms which are furnished by this Office upon request. It is a cause for much gratification that the testing laboratory of this Office is regarded by leading highway engineers of France and England as the most thorough and complete of any road material laboratory in the world. The road authorities of Great Britain arranged through official channels for the testing of a number of samples of road materials from England, shipment to be made during the current fiscal year.

There were in all 735 samples of material tested, which was an increase of 35 over the number tested during the previous fiscal year. Of this number 107 were limestones, 93 were sandstones, and 72 were tars, asphalts, and other bituminous binders, while the remainder represented practically every known road material.

The extent to which our testing laboratories are being utilized by the foremost authorities of road building in this country may be understood by the statement that samples have been tested for the highway commissions of Delaware, Illinois, North Carolina, Pennsylvania, Rhode Island, Virginia, and West Virginia, the geological surveys of Florida, Virginia, and Wisconsin, the engineering department of the District of Columbia, the Chicago Chamber of Commerce, the park commissioners of the city of Chicago, the park commissioners of the city of Philadelphia, the United States Geological Survey, the Isthmian Canal Commission, the War Department, and numerous county officials.

In addition to the routine work, a series of tests was made to show the relation between the crushing strength of slag concrete and stone concrete, and experiments were made to determine the difference in time of setting of Portland cement in combination with various proportions of clay, lime, and plaster of Paris, and to determine the effect of slaked lime in reducing the permeability of Portland cement mortar.

The machine shop was utilized to the utmost extent during the year in perfecting the testing equipment of the Office and in the preparation of the exhibit of this Office at the Alaska-Yukon-Pacific Exposition.

CORROSION OF IRON AND STEEL.

In the letter of transmittal of Bulletin No. 30, on the "Corrosion of Iron," published in May, 1907, I stated that the development of a sheet-iron culvert which was to be at the same time strong, light, and resistant to corrosion would be of great assistance to road builders. I said further that the efforts of the special committee on the corrosion of iron and steel, appointed by the American Society for Testing Materials, of which Doctor Cushman, in charge of the physical and chemical investigations in this Office, is the chairman, would succeed in bringing about an improvement in the quality of metal manufactured for culverts, fence wire, and other purposes of importance to agriculture. This statement has been fully substantiated by the results of the work obtained during the last two years. Manufacturers of culverts are now paying more attention to the quality of the steel which is used and to the efficiency of the galvanized surface. At the same time a great deal of general interest in the subject has been awakened and manufacturers in many parts of the country are not only interested in the special investigations which have been made in this Office, but have also modified their metallurgical methods in line with suggestions that we have made.

In my last annual report I pointed out that steel-wire fencing suffers from corrosion very rapidly and that on this account the farmers of the country have been to a considerable extent handicapped in their efforts to fence their land properly. The test wire fences at Pittsburg, Pa., as well as the steel-plate and pigment tests at Atlantic City, are beginning to yield results of great technologic value and are being closely watched by a number of experts. Both of these sets of exposure tests were made at the instigation of this Office in cooperation with leading associations of manufacturers. All the results obtained by tests of this kind are made a matter of general information and are given out freely for the benefit of the public. It is hoped that by pursuing this problem steadily the important subject of the protection of steel will finally be solved in a great measure. Investigations along these lines in the laboratory are still being made as fast as time and the pressure of routine work permits. The work divides itself naturally into two phases: First, the study of the resistance to corrosion by special steels and irons of great purity, in which the heat treatment which they receive at the works is studied; and second, the development of highly protective coatings.

OUTLINE OF PLANS FOR CURRENT YEAR.

The organization of the Office is now believed to be on a satisfactory basis and no changes will be made except to increase the personnel from time to time as our needs may require and means permit. The work has developed sufficiently to render new projects unnecessary in the immediate future, and it is our plan, therefore, to continue the work during the current year along the same lines as heretofore.

The most important work of an experimental character during the current year is the series of tests of various road materials and methods of construction at Ithaca, N. Y., in cooperation with Cornell University and the state highway commission.

Additional investigations into the possibilities of the sand-clay method of construction will be made during the year, covering a study of various kinds of clay and sand, all feasible combinations, methods of mixing, etc. The slag investigations will be continued and several additional field tests made.

It is hoped to have well under way during the current year a plan for assembling complete data concerning road construction, maintenance, and administration in the United States. The traction tests already conducted by the Office will be supplemented during the current year by additional tests which will be incorporated in a bulletin to be issued bearing upon this subject.

The general advisory work of the Office, the construction of object-lesson roads, the introduction of the split-log drag for the maintenance of earth roads, the testing of road materials, and, in fact, all of the standard projects of the Office, will be developed and broadened as rapidly as possible.

Arrangements have been made whereby this Office will, during the current fiscal year, remove from its present quarters to a more commodious and convenient building at the corner of Fourteenth and B streets, now occupied by the Bureau of Chemistry. This building will be overhauled and improved so as to make it suitable for the work of this Office. The change is made necessary by reason of the fact that the site of the present building has been acquired by the Bureau of Engraving and Printing.

PLANS AND RECOMMENDATIONS FOR 1911.

Since the estimates for the fiscal year 1911 have been submitted without increase, it is not anticipated that there will be any occasion to change or broaden our plans for the next fiscal year. The only change which is recommended in the appropriation bill is a slight rearrangement of the subappropriations involving no increase in amount.

REPORT OF THE SOLICITOR.

U. S. Department of Agriculture,
Office of the Solicitor,
Washington, D. C., October 22, 1909.

Sir: I submit herewith a report of the work of the Office of the Solicitor for the fiscal year ended June 30, 1909.

Respectfully,

Geo. P. McCabe, *Solicitor.*

Hon. James Wilson,
Secretary of Agriculture.

DUTIES OF THE SOLICITOR.

The scope of the work of the Solicitor is outlined in your General Order No. 85 of June 17, 1905, the substance of which was given in the first annual report of this Office. Work along all the lines there set out has steadily increased with each year and reached its maximum during the year closed on June 30 last, when there were reported through the Office, for action in the courts, 928 cases, distributed as follows: Four hundred and ninety-eight cases based on violations of the food and drugs act of June 30, 1906, of which 183, together with 50 reported during the previous year but closed during the present year, resulted in the collection of $5,412, with costs of about equal amount, and condemnation of many tons of goods; 3 cases resulted in verdicts for defendant or claimant; in 1 case motion of United States attorney for leave to file information was denied; in 2 cases goods could not be found; answer of claimant was sustained in another case; in 53 cases no action subsequent to report had been taken during the fiscal year; 135 cases were dismissed, and 120 cases were pending at the close of the year; 208 cases for recovery of penalties under the twenty-eight hour law, a part of which, together with a large number of the 828 cases undisposed of at the close of the previous year, resulted in the collection of penalties and costs amounting to $85,029.85; 33 cases, including some that were undisposed of during the preceding year, resulted in verdicts for the defendants; 81 cases were abandoned because of lack of sufficient evidence to maintain them, and 305 cases, including those undisposed of at the close of the previous year, were pending at the close of the present year; 169 cases involving violations of the cattle quarantine laws, 30 of which resulted in the collection of fines amounting to $3,400 and costs of about half this amount; in 1 case the defendant was committed to jail for thirty days; in another, the defendant was acquitted; 3 cases were dismissed; in 4 cases the grand jury failed to indict; in another the defendant was discharged on preliminary hearing, and 129 cases were pending at the close of the year; 44 cases based on violations of the meat-inspection law, of which 15 resulted in the collection of fines to the amount of $890, together with a substantial amount of costs; 7 cases were dismissed for lack of evidence of shipment or escape of offenders, and 22 cases were pending at the close of the year; 3 cases for recovery of property of the Department, 1 resulting in recovery of the property, and the other 2 were pending at the close of the year; 2 cases for unlawfully and fraudulently personating employees of the Department, both of which resulted in abandonment by the offenders of their misrepresentations: and 1 case each for falsification of accounts resulting in collection of a $250 fine, and for illegal shipment of game resulting in the collection of a fine of $400, and for interference with employees of the Bureau of Animal Industry in the performance of their duties resulting in a full investigation and conditional retention of the offending United States deputy marshal in office. Seven hundred and sixty contracts and bonds were prepared and perfected, and 7 applications to the Commissioner of Patents for letters patent on inventions of Department employees, upon 2 of which, together with 2 coming over from the previous year, patents were granted, and 5 were pending at the close of the year. In addition to many letters, in themselves exhaustive memoranda on legal questions arising in the Department's cases, written in response to requests of the Department of Justice and United States attorneys for the views of the Department relative thereto, this Office, pursuant to similar requests, prepared 13 briefs during the year, covering the constitutionality, construction, and interpretation of the food and drugs act, cattle-quarantine laws, and the twenty-eight hour law. The opinions of the Department contained in 12 of these briefs were sustained either in the courts or by the Attorney-General.

This constitutes the part of the work of the Office during the year which is capable of being briefly and statistically expressed. Each item in the foregoing statement of cases reported for action represents but the result of much preliminary investigation and work necessary to perfect the case for action in the courts. The work of the Office in the enforcement of the food and drugs act alone has increased during the year to an extent out of proportion to the size of the office force, so that it is only with extreme difficulty and extra hours that the work is kept up to date.

In the following topical statement it is practicable to present only a very general outline of the more important features of the work of this Office during the fiscal year.

LEGAL ADVICE.

With the extension of operations of the Department incident to recent acts of Congress and to growing importance of agricultural pursuits in the United States arise many and important questions of law, and, what is closely connected with it, policy, frequent opinions upon which, both written and oral, have been rendered the Secretary and the various chiefs of Bureaus by the Solicitor during the year. Scarcely a day passed during the entire year without the submission of one or more of these questions. Many of the matters were of such a confidential nature that their mention in this report is impracticable.

COMMUNICATIONS TO THE DEPARTMENT OF JUSTICE.

FOOD AND DRUGS ACT.

Four hundred and ninety-four cases of violations of the food and drugs act of June 30, 1906, were reported by the Department to the Attorney-General and United States attorneys during the fiscal year, 359 more than were so reported during the previous year. Of these 494 cases, 85 resulted in convictions in criminal prosecutions, almost wholly upon pleas of guilty, and the imposition of fines amounting to $2,002, and costs of equal, if not greater, amount, an accurate statement of which can not be given here as the figures were not available in time for this report; 98 resulted in decrees of condemnation and forfeiture under section 10 of the act, carrying with them costs of substantial amounts which were paid by claimants of the goods; 1 case resulted in a verdict for the defendant; in another case a motion of the United States attorney for leave to file an information was denied by the court; in 2 seizure cases the goods could not be found; in 1, answer of claimant was sustained and libel dismissed; in 2 seizure cases tried by a jury verdicts were found for claimant, under instruction of the court, and appeal taken by the Government, which is now pending in the Circuit Court of Appeals; 135 cases were dismissed either before action commenced or before issue raised in the courts; in 53 cases no action after report had been taken before the close of the year; and 74 criminal and 42 seizure cases were pending in the courts at the close of the year. It will be seen that of the cases reported during the year, 135 were dismissed. It must not be inferred from this that there was anything inherently defective in the evidence submitted by the Department in much the larger number of these cases. They all represented substantial violations of the act and the proof in all but a few of them was ample to sustain prosecutions, but due regard was had for circumstances of mitigation and palliation, and, in many instances, excuse, which commended themselves to that discretion which must reside in any Department of the Government charged with the duty of administering an act of Congress, and as a result the Department recommended to the Attorney-General and the United States attorney discontinuance of a number of these cases, either after or before action commenced. Other cases were abandoned because of slight imperfections in the chain of evidence to establish the interstate shipment. In addition to the above cases, both reported and finally determined during the year, there were 40 criminal and 10 seizure cases reported during the previous year, but finally disposed of during the present year by convictions and imposition of fines aggregating $3,410, exclusive of about an equal amount of costs, and decrees of condemnation and forfeiture of goods with attendant costs on the claimants, thus amounting on the whole during the year to 125 convictions, with consequent fines of $5,412, and 108 decrees of condemnation and forfeiture of many tons of goods.

Few of the cases under this act have been contested, the defendants in criminal and claimants in forfeiture cases seeming to prefer pleas of guilty and admissions of the allegations of the libels. There have been, therefore, very few questions raised for determination by the courts. Yet the most vital question, that of the constitutionality of the act, was raised by the claimants early in the year in the western district of Missouri in the case of the United States *v.* 100 cases of Tepee apples and 172 cases of Tepee blackberries, reported in Notice of Judgment No. 36 of the Department, wherein the court sustained the validity of the act. In two contested cases, both proceedings under section 10 for seizure, condemnation, and forfeiture of goods, one in the district of Maryland and the other in the northern district of West Virginia, the claimants excepted to the libels on the alleged ground that no hearing had been accorded them by the Secretary, their contention being that the hearing provided for by section 4 of the act extends as well to proceedings under section 10 as to criminal prosecutions under sections 1 and 2. Elaborate arguments were made in behalf of the claimants in an attempt to show a purpose on the part of Congress to extend this preliminary right in criminal cases to cases under section 10, but in well-considered opinions the courts overruled the contention, holding that section 4, so far as it provides for hearing before the Secretary, has no application to proceedings under section 10 directed against the goods themselves. The opinion of Judge Morris, of the district of Maryland, in the case of the United States *v.* 50 barrels of whisky, is reported in Circular No. 10 of this Office and in 165 Federal Reporter, 966. The opinion of Judge Dayton, of the northern district of West Virginia, in the case of the United States *v.* 65 casks of liquid extracts, is reported in 170 Federal Reporter, 449. It was also contended by the claimant in the case of the United States *v.* 65 casks of liquid extracts, above referred to, that the provision of section 8 of the act that a food or drug shall be deemed to be misbranded "if the package fail to bear a statement on the label of the quantity or proportion of any alcohol, morphine," etc., does not require a label to be placed on packages of foods and drugs containing these substances, and hence if the manufacturer and shipper of such goods omits to put a label on them, the content of alcohol, morphine, etc., need not be stated, and no violation of the act is committed. In other words, the substance of the argument was that if the package bear a label the content of alcohol must be stated thereon, but if no label is put on the package the content of alcohol need not be stated. This contention was argued by the claimant at much length and with apparent confidence in the correctness of this interpretation of the act, but the court overruled it.

One other question of importance was raised during the year. In a prosecution in the district of New Jersey against the Oriental Dragee Company for shipment of confectionery adulterated with metallic silver, the defendant contended that it was incumbent on the Government to allege in the information and prove at the trial that this silver was not only a mineral substance, but also that it was poisonous and deleterious or detrimental to health. It was further contended that the term "other mineral substance" in section 7 of the act should be construed, according to the principle of ejusdem generis, to include only mineral substances of the same particular description as those specifically mentioned in the preceding part of the sentence, and that, so construed, metallic silver was not included, and foods containing it are therefore not adulterated. In a well-considered opinion the court overruled the contention. The defendant was tried, convicted, and sentenced to pay a fine of $100. The same question was also raised by defendant's demurrer in the case of United States *v.* French Silver Dragee

Company, in the southern district of New York, but the demurrer was overruled, a plea of not guilty entered, and the case was pending for trial at the close of the year.

In January of the present fiscal year, as a result of Food Inspection Decision No. 100, wherein the Secretary published his findings that flour bleached with nitrogen peroxid is adulterated and misbranded, the Alsop Process Company, of St. Louis, Mo., filed its petition in the Supreme Court of the District of Columbia against the Secretary of Agriculture praying a writ of mandamus to compel the Secretary to withhold the recommendation of prosecutions against manufacturers and shippers of flour bleached by the Alsop process, owned and controlled by the petitioners, and to revoke, cancel, and annul the decision and refrain from circulating further copies of it. The answer of the Secretary denying the right of petitioners to the writ was duly filed and the issue thereby made elaborately argued, and the writ denied by the court. An appeal was prosecuted to the Court of Appeals of the District of Columbia, where the decision of the Supreme Court was sustained.

Near the close of the year a bill was filed in the Supreme Court of the District of Columbia by the Hipolite Egg Company against the Secretary of Agriculture, praying that an injunction be granted restraining the Secretary from further enforcement of the food and drugs act, both as respects the complainant and all others similarly affected by the act. This suit grew out of a proceeding under section 10 of the act, in the southern district of Illinois, for seizure and condemnation of 50 cases of eggs adulterated with boric acid, prepared by the Hipolite Egg Company and shipped by it from St. Louis, Mo., to Peoria, Ill. The basis of the prayer for an injunction is the alleged unconstitutionality of the act. The matter was presented to the court on behalf of complainants in June and a preliminary injunction refused, but a rule on the Secretary to show cause why an injunction should not be granted was allowed and made returnable in the early part of August. The case was pending on this rule at the close of the year.

The following tables, separated because of difference in character of the two classes of cases, show those cases in which some definite action was taken during the year other than dismissal or abandonment by the Government, subsequent to report to the Attorney-General or the United States attorneys.

CRIMINAL.

Cases under the food and drugs act of June 30, 1906, reported for criminal prosecution during the fiscal years 1908 and 1909, and finally determined during the latter year or pending in the courts at its close.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or present status of case.
6	Clark, Coggin & Johnson Co.	Massachusetts	Shipment from Massachusetts to the District of Columbia of misbranded coffee.	Information filed; pending.
26	Western Reserve Syrup Co.	Ohio, northern district.	Shipment of misbranded maple sirup from Ohio to Michigan.	Defendant convicted; fined $50.
29	Paddock Coffee and Spice Co.	Missouri, western district.	Shipment of adulterated and misbranded vanilla extract from Missouri to Kansas.	Defendant pleaded guilty; fined $25.
36	Christ Jannet	Illinois, eastern district.	Shipment of adulterated milk from Illinois to Missouri.	Defendant pleaded guilty; fined $100.
45	William Gornet	Illinois, southern district.	do	Do.

Cases under the food and drugs act of June 30, 1906, reported for criminal prosecution during the fiscal years 1908 and 1909, and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or present status of case.
46	Henry C. Taake	Illinois, southern district.	Shipment of adulterated milk from Illinois to Missouri.	Defendant pleaded guilty; fined $100.
48	Charles Goetz	do	do	Do.
50	George Scheck	do	do	Do.
52	Charles Schultz	do	do	Do.
53	Jacob Bleisch	do	do	Do.
55	August Schultze	do	do	Do.
56	Ben Schultze	do	do	Do.
59	William Gornet	do	do	Do.
60	C. Taylor	do	do	Do.
61	George Wittman	do	do	Do.
62	Ed. Libert	Illinois, eastern district.	do	Do.
64	William Karhoff	do	do	Do.
65	F. J. Dressler	do	do	Do.
66	William Hussman	do	do	Defendant convicted; fined $100.
67	Ernest Schrieber	do	do	Defendant pleaded guilty; fined $100.
68	John P. Bentler	do	do	Do.
69	O'Fallon Creamery (John Munier).	do	do	Do.
70	do	do	do	Do.
71	George Schwehr	Illinois, southern district.	do	Do.
72	Adam Schmitt	do	do	Do.
74	Adreas Griebler	Illinois, eastern district.	do	Defendant acquitted.
76	E. Franklin	Illinois, southern district.	do	Defendant pleaded guilty; fined $100.
79	Ed. Garde	do	do	Do.
80	Henry Brandemeyer.	do	do	Do.
95	Gowan Manufacturing Co.	Illinois, northern district.	Shipment of misbranded drug from Illinois to the District of Columbia.	Defendant pleaded guilty; fined $200 and costs, $15.95.
98	Cumberland Manufacturing Co.	Tennessee, middle district.	Shipment of misbranded lemon extract from Tennessee to Kentucky.	Defendant pleaded guilty; fined $100.
99	Nave-McCord Mercantile Co.	Missouri, western district.	Shipment of misbranded lemon extract from Missouri to Kansas.	Information filed; tried to the court without jury; pending.
100	Elgin Creamery Co.	District of Columbia.	Sale of misbranded butter in the District of Columbia.	Defendant pleaded guilty; fined $100.
112	Westport Cereal Mills (S. V. Smith, proprietor).	Missouri, western district.	Shipment of adulterated and misbranded buckwheat flour from Missouri to Kansas.	Defendant pleaded guilty; fined $25.
113	Paddock Coffee and Spice Co.	do	Shipment of misbranded lemon flavor from Missouri to Kansas.	Do.
117	Long Brothers Grocery Co.	do	Shipment of adulterated and misbranded pepper from Missouri to Kansas.	Do.
118	W. G. Dean & Son.	New York, southern district.	Shipment of adulterated and misbranded pepper from New York to the District of Columbia.	Information filed; pending.
119	Kimball Bros. & Co.	Vermont	Shipment of misbranded lemon extract from Vermont to New Hampshire.	Defendant pleaded guilty; fined $100.
121	Edward Westen Tea and Spice Co.	Missouri, eastern district.	Shipment of adulterated and misbranded lemon extract from Missouri to Kansas.	Information filed pending.
122	Ennis-Hanly-Blackburn Coffee Co.	Missouri, western district.	Shipment of misbranded lemon extract from Missouri to Kansas.	Defendant pleaded guilty; fined $25.
124	C. Read & Co.	Maryland	Shipment of adulterated and misbranded buckwheat flour from Maryland to Delaware.	Do.
126	Getz Bros. & Co.	California, northern district.	Shipment of adulterated and misbranded olive oil from California to Washington.	Defendant pleaded guilty; fined $100.
127	Roth - Homeyer Coffee Co.	Missouri, eastern district.	Shipment of adulterated and misbranded lemon extract from Missouri to Oklahoma.	Information filed; pending.

Cases under the food and drugs act of June 30, 1906, reported for criminal prosecution during the fiscal years 1908 and 1909, and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or present status of case.
129	The Eyelin Co.	Illinois, northern district.	Shipment of a misbranded drug from Illinois to the District of Columbia.	Defendant pleaded guilty; fined $10.
131	Thomson-Taylor Spice Co.	do	Shipment of adulterated and misbranded lemon extract from Illinois to Missouri.	Defendant pleaded guilty; fined $100.
132	do	do	do	Do.
133	Suffolk Drug and Extract Co.	Virginia, eastern district.	Shipment of adulterated and misbranded lemon extract from Virginia to North Carolina.	Defendant pleaded guilty; fined $25.
137	Heekin Spice Co.	Ohio, southern district.	Shipment of adulterated and misbranded lemon extract from Ohio to Kentucky.	Defendant pleaded guilty; fined $5 and costs, $19.27.
142	Globe Pharmaceutical Co. (Pilkinton & Foose, partners).	do	Shipment of misbranded drug from Ohio to the District of Columbia.	Defendants pleaded guilty; fined $5 each.
143a	Fort Des Moines Canning Co.	Oklahoma, western district.	Delivery in original packages of 678 cases of misbranded canned corn shipped from Iowa to Oklahoma.	Defendant pleaded guilty; fined $100.
148a	J. W. Ogburn	do	Delivery in original packages of 797 boxes of misbranded canned blackberries shipped from Texas to Oklahoma.	Do.
156	Victor Remedy Co.	Ohio, southern district.	Shipment of misbranded drug from Ohio to Michigan.	Defendant pleaded guilty; fined $10 and costs, $13.90.
159	Hastings Milling Co.	Minnesota	Shipment of adulterated and misbranded rye flour from Minnesota to Iowa.	Defendant pleaded guilty; fined $10.
162	H. Boeckmann	New York, eastern district.	Shipment of adulterated and misbranded honey from New York to New Jersey.	Information filed; pending on demurrer thereto.
166	Louis Horpel & Co.	Maryland	Shipment of adulterated and misbranded buckwheat flour from Maryland to Delaware.	Defendant pleaded guilty; fined $10.
177	John A. Tolman & Co.	Illinois, northern district.	Shipment of misbranded maple sirup from Illinois to Iowa.	Information filed; demurrer thereto; pending.
180	Arlington Bottling Co. (Chas. Jacobsen, proprietor).	District of Columbia.	Manufacture and sale in District of Columbia of misbranded lithia water.	Defendant pleaded guilty; fined $100.
190	Chas. Spies & Co.	Missouri, western district.	Shipment of adulterated and misbranded pepper from Missouri to Kansas.	Defendant pleaded guilty; fined $25.
191	do	do	Shipment of adulterated and misbranded lemon extract from Missouri to Kansas.	Do.
194	Haynor Manufacturing Co.	Virginia, eastern district.	Shipment of adulterated and misbranded lemon extract from Virginia to North Carolina.	Defendant convicted; motions in arrest of judgment and for new trial pending.
202	R. C. Williams & Co.	New York, southern district.	Shipment of misbranded maple sirup from New York to New Jersey.	Information filed; pending.
213	Oriental Dragee Co.	New Jersey	Shipment of adulterated confectionery (silver dragees) from New Jersey to New York.	Defendant convicted; fined $100.
215	Webb Manufacturing Co.	Tennessee, middle district.	Shipment of adulterated and misbranded lemon extract from Tennessee to North Carolina.	Information filed; pending.
220	Rigney & Co.	New York, eastern district.	Shipment of adulterated and misbranded maple sirup from New York to Pennsylvania.	Do.
222	J. W. Biles & Co.	Ohio, southern district.	Shipment of misbranded "dried distillers' grains" from Ohio to New York.	Defendant pleaded guilty; fined $1 and costs, $13.85.
223	L. Sonneborn & Sons.	New Jersey	Shipment of adulterated and misbranded saltpeter from New Jersey to Illinois.	Defendant pleaded non vult; fined $50.
224	Standard Trading Co. (Gouid Brina, proprietor).	New York, southern district.	Shipment of misbranded cotton salad oil from New York to New Jersey.	Defendant convicted; fined $100.

Cases under the food and drugs act of June 30, 1906, reported for criminal prosecution during the fiscal years 1908 and 1909, and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or present status of case.
226	M. A. Newmark & Co.	California, southern district.	Shipment of adulterated and misbranded buckwheat flour from California to Nevada.	Defendant pleaded guilty; fined $10.
230	C. F. Sauer & Co..	Virginia, eastern district.	Shipment of adulterated and misbranded lemon extract from Virginia to North Carolina.	Defendant pleaded guilty; fined $25.
231	Bruns Bros. Grocery Co.	Ohio, southern district.	Guaranty of misbranded apples shipped from Ohio to Illinois.	Defendant pleaded guilty; fined $1 and costs, $14.20.
232	St. Louis Coffee and Spice Mills.	Missouri, eastern district.	Shipment of adulterated and misbranded vanilla extract from Missouri to Kansas.	Verdict for defendant under instruction of the court.
239	Powell-Sanders Co.	Washington, eastern district.	Shipment of adulterated and misbranded pepper from Washington to Idaho.	Defendant pleaded guilty; fined $100.
241	Dwight Edwards Co.	Oregon..........	Shipment of misbranded lemon extract from Oregon to Idaho.	Defendant pleaded guilty; fined $25.
242	The Southern Cider and Vinegar Co.	Virginia, eastern district.	Shipment of adulterated and misbranded vinegar from Virginia to North Carolina.	Information filed; pending.
243	The Edward Westen Tea and Spice Co.	Missouri, eastern district.	Shipment of adulterated and misbranded lemon extract from Missouri to Indian Territory.	Do.
244	W. J. Lamb Co....	Massachusetts.....	Shipment of misbranded honey from Massachusetts to Connecticut.	Do.
249	D. R. Dupuis (Dr. Rupert Wells).	Missouri, eastern district.	Shipment of misbranded drug (radol) from Missouri to the District of Columbia.	Defendant pleaded guilty; fined $100 and costs, $16.30.
250	The Edgerton Creamery Co. (J. B. Todd).	Kansas..........	Shipment of adulterated cream from Kansas to Missouri.	Defendant pleaded guilty; fined $10.
253	S. W. Weidler Co..	Ohio, southern district.	Shipment of misbranded meal from Ohio to Virginia.	Information filed; pending.
260	M. S. Piercy......	Kansas..........	Shipment of adulterated milk from Kansas to Missouri.	Defendant pleaded guilty; fined $10.
262	Jacob Meyer......	.....do..........	.....do..........	Do.
263	J. W. Earnshaw...	.....do..........	.....do..........	Do.
266	M. Shoemaker.....	.....do..........	.....do..........	Do.
268	Great Western Cereal Co.	Illinois, northern district.	Shipment of misbranded cattle feed from Illinois to Indiana.	Information filed; demurrer thereto; pending.
272	Pacific Coast Syrup Co.	California, southern district.	Shipment of misbranded sirup from California to Arizona.	Defendant pleaded guilty; fined $10.
274	Nathan Tucker...	Ohio, southern district.	Shipment of misbranded drug from Ohio to the District of Columbia.	Information filed; pending.
275	Huntington Maple Syrup and Sugar Co.	Rhode Island.....	Shipment of misbranded sirup from Rhode Island to the District of Columbia.	Motion of Government for leave to file information denied.
281	H. B. Staley Co...	Virginia, western district.	Shipment of adulterated and misbranded buckwheat flour from Virginia to West Virginia.	Defendant, H. B. Staley, pleaded guilty; fined $10; information dismissed as to T. F. Staley.
283	Audubon Canning Co.	Iowa, southern district.	Shipment of misbranded canned corn from Iowa to Utah.	Information filed; pending.
286	A. J. Hilbert & Co.	Wisconsin, eastern district.	Shipment of misbranded lemon extract from Wisconsin to Minnesota.	Do.
291	Edward Westen Tea and Spice Co.	Missouri, eastern district.	Shipment of misbranded banana extract from Missouri to Oklahoma.	Do.
295	King Bros., Shilstone & Saint.	Louisiana, eastern district.	Shipment of misbranded olive oil from Louisiana to Texas.	Defendant pleaded guilty; fined $10.
298	Monroe Pharmacal Co.	New York, western district.	Shipment of adulterated and misbranded vanilla extract from New York to Massachusetts.	Defendant pleaded guilty; sentence suspended.
299	Dwight Edwards Co.	Oregon..........	Shipment of misbranded strawberry extract from Oregon to Montana.	Defendant pleaded guilty; fined $25.
300	.....do..........	.....do..........	Shipment of misbranded raspberry extract from Oregon to Montana.	Do.

Cases under the food and drugs act of June 30, 1906, reported for criminal prosecution during the fiscal years 1908 and 1909, and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or present status of case.
302	J. H. Barker & Co.	New York, southern district.	Shipment of misbranded sirup from New York to Maryland.	Information filed; pending.
306	Mobile Drug Co.	Alabama, southern district.	Shipment of adulterated and misbranded pineapple extract from Alabama to Mississippi.	Defendant pleaded guilty; fined $25.
309	The La Cottel Manufacturing Co.	Michigan, eastern district.	Shipment of misbranded drug from Michigan to Ohio.	Defendant pleaded nolo contendere; fined $10.
310	P. Hohenadel, jr., Co.	Illinois, northern district.	Shipment of misbranded peas from Illinois to Indiana.	Information filed; pending.
311	D. B. Scully Syrup Co.	do	Shipment of adulterated and misbranded sirup from Illinois to Washington.	Do.
312	The D. R. Wilder Manufacturing Co.	Georgia, northern district.	Shipment of misbranded sirup from Georgia to Mississippi.	Defendant convicted; fined $25 and costs, $214.70.
313	Pacific Coast Syrup Co.	Oregon	Shipment of adulterated and misbranded sirup from Oregon to Washington.	Defendant pleaded guilty; fined $25.
314	Michigan Starch Co.	Michigan, western district.	Shipment of misbranded stock feed from Michigan to New York.	Defendant pleaded guilty; fined $50.
316	W. G. Dean & Son	New York, southern district.	Shipment of adulterated and misbranded pepper from New York to Washington.	Information filed; plea not guilty; pending.
318	Forbes Bros. Tea and Spice Co.	Missouri, eastern district.	Shipment of adulterated and misbranded lemon extract from Missouri to Mississippi.	Information filed; pending.
319	Haynor Manufacturing Co.	Virginia, eastern district.	Shipment of adulterated and misbranded vanilla flavor from Virginia to North Carolina.	Defendant convicted; motion for new trial pending.
322	Scudder Syrup Co.	Illinois, northern district.	Shipment of misbranded sirup from Illinois to Kansas.	Information filed; pending.
323	do	do	Shipment of misbranded sirup from Illinois to Washington.	Do.
324	do	do	do	Do.
331	Moshier Bros.	Massachusetts	Shipment of adulterated and misbranded drug from Massachusetts to Rhode Island.	Do.
332	Scudder Syrup Co.	Illinois, northern district.	Shipment of misbranded sirup from Illinois to Michigan.	Do.
333	do	do	Shipment of misbranded sirup from Illinois to North Carolina.	Do.
334	Forbes Bros. Tea and Spice Co.	Missouri, eastern district.	Shipment of adulterated and misbranded lemon extract from Missouri to Texas.	Do.
335	The Russ Co.	Indiana	Shipment of adulterated and misbranded flour from Indiana to Ohio.	Affidavit filed; grand jury failed to indict; pending.
339	Hunter Bros. Milling Co.	Missouri, eastern district.	Shipment of misbranded cotton-seed meal from Missouri to New York.	Defendant pleaded guilty; fined $10.
341	Forbes Bros. Tea and Spice Co.	do	Shipment of adulterated and misbranded strawberry extract from Missouri to Mississippi.	Information filed; pending.
342	W. G. Dean & Son.	New York, southern district.	Shipment of adulterated and misbranded pepper from New York to Washington.	Information filed; plea not guilty; pending.
346	F. B. Chamberlain Co.	Missouri, eastern district.	Shipment of misbranded flour from Missouri to Minnesota.	Information filed; pending.
348	Ela Manufacturing Co.	Illinois, southern district.	Shipment of adulterated and misbranded flour from Illinois to Ohio.	Defendant convicted; fined $25.
349	The King Cereal and Manufacturing Co.	Illinois, northern district.	do	Information filed; pending.
350	King Bros., Shilstone & Saint.	Louisiana, eastern district.	Shipment of adulterated and misbranded olive oil from Louisiana to Mississippi.	Defendants pleaded guilty; fined $10.
353	Marshalltown Syrup and Sugar Co.	Iowa, southern district.	Shipment of misbranded sirup from Iowa to Nebraska.	Information filed; pending.

Cases under the food and drugs act of June 30, 1906, reported for criminal prosecution during the fiscal years 1908 and 1909, and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or present status of case.
363	Thomas Corbin	Kentucky, eastern district.	Shipment of milk adulterated with water from Kentucky to Ohio.	Defendant pleaded guilty; fined $15.
364	W. M. Fricke	do	do	Do.
365	W. F. Johnson	do	do	Do.
366	B. M. Mullins & Sons.	do	do	Do.
367	Joseph Geiger	do	do	Do.
368	Theodore Grager	do	do	Do.
369	Henry Nostheide	do	do	Do.
370	Charles Peoples, jr.	do	do	Do.
372	W. T. Hogan	do	do	Do.
373	Henry Grager	do	do	Do.
374	J. C. Kirby	do	do	Do.
375	John Miner	do	do	Do.
376	Owen Dunaway	do	do	Do.
377	Stephen Schacle	do	do	Do.
378	W. H. Perry	do	do	Do.
379	Henry Ducker	do	do	Do.
380	B. Evers & Son	do	do	Do.
414	Willie Reeves	do	do	Do.
418	R. E. Funsten Dried Fruit and Nut Co.	Missouri, eastern district.	Shipment of misbranded evaporated apples from Missouri to Ohio.	Information filed; pending.
419	New England Food Co.	Connecticut	Shipment of misbranded "Nivara Cereal Food" from Connecticut to Massachusetts.	Defendant pleaded guilty; fined $10.
422	Clinton Sugar Refining Co.	Iowa, southern district.	Shipment of misbranded gluten feed from Iowa to New York.	Information filed; pending.
428	The Ennis-Hanly-Blackburn Coffee Co.	Missouri, western district.	Shipment of adulterated and misbranded vanilla extract from Missouri to Kansas.	Defendant pleaded guilty; fined $25.
429	R. E. Funsten Dried Fruit and Nut Co.	Missouri, eastern district.	Shipment of misbranded dried apples from Missouri to Indiana.	Information filed; pending.
432	Chas. Meizesahl Manufacturing Co.	New York, southern district.	Shipment of misbranded mineral water from New York to Pennsylvania.	Defendant pleaded guilty; fined $50.
436	Wisconsin Butter and Cheese Co.	Wisconsin, eastern district.	Shipment of milk, adulterated with water, from Wisconsin to Illinois.	Information filed; pending.
437	do	do	do	Do.
438	William Huff	do	do	Do.
439	M. Boyle	do	do	Defendant pleaded guilty; fined $25.
440	C. E. Williams	do	do	Do.
441	J. C. Katzenburg	do	do	Do.
442	W. E. Bruce	Indiana	Shipment of milk, adulterated by abstraction of cream, from Indiana to Illinois.	Defendant pleaded guilty; fined $10.
444	M. J. Klein	do	Shipment of milk, adulterated with water, from Indiana to Illinois.	Do.
445	Frank Stark	do	do	Do.
453	Berry-Maybrun Co.	Illinois, northern district.	Shipment of misbranded sirup from Illinois to Iowa.	Information filed; pending.
458	French Silver Dragee Co.	New York, southern district.	Shipment of adulterated confectionery from New York to California.	Information filed; demurrer thereto overruled; plea not guilty; pending.
459	do	do	do	Do.
461	Michigan Starch Co.	Michigan, western district.	Shipment of misbranded feed from Michigan to New York.	Defendant pleaded guilty; fined $50.
462	The A. Colburn Co.	Pennsylvania, eastern district.	Shipment of adulterated and misbranded vanilla extract from Pennsylvania to Arizona.	Information filed; pending.
464	Thomson & Taylor Spice Co.	Illinois, northern district.	Shipment of adulterated and misbranded lemon extract from Illinois to Minnesota.	Do.
465	The C. F. Sauer Co.	Virginia, eastern district.	Shipment of misbranded vanilla extract from Virginia to North Carolina.	Defendant pleaded guilty; fined $25.
471	Christian Bros. Co.	do	Shipment of adulterated and misbranded lemon extract from Virginia to North Carolina.	Defendant pleaded guilty; sentence suspended.

Cases under the food and drugs act of June 30, 1906, reported for criminal prosecution during the fiscal years 1908 and 1909, and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or present status of case.
473	E. A. Charbonneau Co.	Michigan, eastern district.	Shipment of adulterated and misbranded sirup from Michigan to Ohio.	Defendant pleaded nolo contendere; fined $10.
475	The O. P. Hooper Chemical Co.	Pennsylvania, eastern district.	Shipment of misbranded drug (anodyne) from Pennsylvania to Delaware.	Information filed; pending.
476	Kneipp Malt Food Co.	Wisconsin, eastern district.	Shipment of misbranded coffee from Wisconsin to Pennsylvania.	Do.
479	King Bros., Shilstone & Saint.	Louisiana, eastern district.	Shipment of adulterated and misbranded strawberry extract from Louisiana to Mississippi.	Defendant pleaded guilty; fined $10.
481	S. J. Van Lil Co.	Maryland	Shipment of adulterated and misbranded tomato catsup from Maryland to Massachusetts.	Information filed; pending.
482	Albert Mackie Grocer Co.	Louisiana, eastern district	Shipment of misbranded lemon extract from Louisiana to Mississippi.	Defendant pleaded guilty; fined $10.
483	Price & Lucas Cider and Vinegar Co.	Pennsylvania, western district.	Shipment of adulterated and misbranded vinegar from Pennsylvania to Ohio.	Information filed; pending.
484	H. B. Howell & Co.	Louisiana, eastern district.	Shipment of adulterated and misbranded strawberry flavor from Louisiana to Mississippi.	Defendant pleaded guilty; fined $10.
486	Mobile Drug Co.	Alabama, southern district.	Shipment of adulterated and misbranded lemon extract from Alabama to Mississippi.	Defendant pleaded guilty; see No. 306, two offenses in one information.
494	Hanley & Kinsella Coffee and Spice Co.	Missouri, eastern district.	Shipment of adulterated and misbranded pepper from Missouri to New Mexico.	Information filed; pending.
495	Calumet Tea and Coffee Co.	Illinois, northern district.	Shipment of adulterated and misbranded pepper from Illinois to Montana.	Do.
496	Westfeldt Bros.	Louisiana, eastern district.	Shipment of adulterated coffee from Louisiana to Tennessee.	Defendant pleaded guilty; fined $10.
497	Audubon Canning Co.	Iowa, southern district.	Shipment of misbranded canned corn from Iowa to California.	Information filed pending.
498	Merten & Co.	California, northern district.	Shipment of adulterated and misbranded lemon extract from California to Montana.	Do.
499	Bay State Maple Syrup Co.	Massachusetts	Shipment of misbranded sirup from Massachusetts to Delaware.	Do.
502	Atwood & Steele Co.	Illinois, northern district.	Shipment of adulterated and misbranded lemon extract from Illinois to Idaho.	Do.
505	W. B. Glofke Co.	Oregon	Shipment of adulterated and misbranded sirup from Washington to Oregon.	Defendant pleaded guilty; fined $25 and costs, $33.82.
506	Sweet Valley Wine Co.	Ohio, northern district.	Shipment of adulterated and misbranded wine from Ohio to Pennsylvania.	Indictment filed; pending.
510	do	do	do	Do.
511	do	do	do	Do.
512	do	do	do	Do.
513	do	do	do	Do.
515	John H. Fitch & Co.	do	Shipment of misbranded vanilla extract from Ohio to Pennsylvania.	Defendant pleaded guilty; fined $25.
516	Chas. L. Heinle Specialty Co.	Pennsylvania, eastern district.	Shipment by vendees of defendant guarantor of adulterated and misbranded vanilla extract from Pennsylvania to Delaware.	Information filed; pending.
519	Nicholas Burke Co.	Louisiana, eastern district.	Shipment of misbranded vanilla extract from Louisiana to Mississippi.	Defendant pleaded guilty; fined $10.
520	Closset & Devers.	Oregon	Shipment of adulterated and misbranded lemon extract from Oregon to Washington.	Defendant pleaded guilty; fined $25 and costs, $36.12.
521	Marshalltown Syrup and Sugar Co.	Iowa, southern district.	Shipment of misbranded sirup from Iowa to Colorado.	Information filed; pending.

Cases under the food and drugs act of June 30, 1906, reported for criminal prosecution during the fiscal years 1908 and 1909, and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or present status of case.
536	McCormick & Co.	Maryland	Shipment of misbranded vanilla compound from Maryland to Virginia.	Defendant pleaded guilty; fined $20.
542	The Newton Tea and Spice Co.	Ohio, southern district.	Shipment of adulterated and misbranded pepper from Ohio to Mississippi.	Information filed; pending.
550	Towns & James	New York, eastern district.	Guaranty of adulterated and misbranded hydrogen peroxid shipped from New York to Massachusetts.	Information filed; demurrer thereto; pending.
551	La Manna, Azema & Farnan.	New York, southern district.	Guaranty of adulterated silver dragees shipped from New York to New Jersey.	Information filed; plea not guilty; pending.
552	Muscatine French Cheese Co.	Iowa, southern district.	Shipment of misbranded cheese from Iowa to Illinois.	Information filed; pending.
556	Ralston Purina Co.	Missouri, eastern district.	Shipment of misbranded animal feed from Missouri to Ohio.	Do.
557	O. L. Gregory Vinegar Co.	Alabama, northern district.	Shipment of adulterated and misbranded vinegar from Alabama to Georgia.	Do.
558	MacLaren Imperial Cheese Co.	Michigan, eastern district.	Shipment of adulterated cheese from Michigan to Illinois.	Do.
559	Dennis Rupert Dupuis.	Missouri, eastern district.	Shipment of misbranded drug (radol) from Missouri to the District of Columbia.	Do.
561	MacLaren Imperial Cheese Co.	Michigan, eastern district.	Shipment of adulterated cheese from Michigan to Massachusetts.	Do.
569	Celery-Cracker Medicine Co.	New Hampshire	Shipment of misbranded drug from New Hampshire to Vermont.	Defendant pleaded nolo contendere; fined $25 and costs, $25.
571	Bertin & Lepori	California, northern district.	Shipment of adulterated and misbranded olive oil from California to New Mexico.	Information filed; pending.
578	Midland Grocery Co.	Colorado	Shipment of adulterated bitter-almond extract from Colorado to Kansas.	Defendant pleaded guilty; fined $10 and costs, $17.93.
585	The Rye-Ola Co.	Alabama, northern district.	Shipment of misbranded sirup from Alabama to Louisiana.	Information filed; pending.
586	The Wiseola Co.	do.	do.	Do.
605	Bay State Maple Syrup Co.	Massachusetts	Shipment of misbranded sirup from Massachusetts to New York.	Do.
611	The Baker Preserving Co.	Colorado	Shipment of adulterated and misbranded sirup from Colorado to Nebraska.	Do.

CONDEMNATION.

Cases under section 10 of the food and drugs act of June 30, 1906, reported during the fiscal years 1908 and 1909 and finally determined during the latter year or pending in the courts at its close.

F. & D. case No.	Claimant.	Judicial district.	Subject of offense.	Disposition or present status of case.
4 E	Louisiana Distillery Co.	Maryland	50 barrels of misbranded whisky shipped from Louisiana to Maryland.	Decree of condemnation and forfeiture rendered.
15	James Clark Distilling Co.	District of Columbia.	45 barrels of adulterated and misbranded whisky offered for sale in the District of Columbia.	Libel filed; seizure effected; pending.
19	C. H. Godfrey & Son.	Missouri, western district.	242 cases of canned blackberries and 100 cases of canned apples, misbranded as to place of production, shipped from Arkansas to Missouri.	Decree of condemnation and forfeiture rendered.
20	Rogers, Holloway Co.	Michigan, eastern district.	10 cases of adulterated and misbranded honey shipped from Pennsylvania to Michigan.	Do.

Cases under section 10 of the food and drugs act of June 30, 1906, reported during the fiscal years 1908 and 1909 and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Claimant.	Judicial district.	Subject of offense.	Disposition or present status of case.
20a	Rogers, Holloway Co.	Michigan, eastern district.	6 barrels of adulterated and misbranded honey shipped from Pennsylvania to Michigan.	Decree of condemnation and forfeiture rendered.
20b	....do............	.....do............	8 barrels of adulterated and misbranded honey shipped from Pennsylvania to Michigan.	Do.
20c	....do............	.....do............	200 cases of adulterated and misbranded honey shipped from Pennsylvania to Michigan.	Do.
22	Western Reserve Syrup Co.	Michigan, western district.	20 dozen quarts of misbranded maple sirup shipped from Ohio to Michigan.	Do.
87	Oklahoma Supply Co.	Oklahoma, western district.	65 barrels of adulterated and misbranded vinegar shipped from Illinois to Oklahoma.	Do.
89	Orrville Milling Co.	Virginia, eastern district.	800 sacks of misbranded flour shipped from Ohio to Virginia.	Do.
94	Hiram Walker & Sons.	Michigan, eastern district.	5,000 cases of adulterated and misbranded whisky shipped from Canada to Michigan.	Libel filed; seizure effected; pending.
96	Reily-Taylor Co...	Georgia, northern district.	36 cases of adulterated and misbranded coffee shipped from Louisiana to Georgia.	Decree of condemnation and forfeiture rendered.
102	Adam Dillman & Co.	Wisconsin, eastern district.	51 cases of adulterated and misbranded whisky shipped from Michigan to Wisconsin.	Libel filed; seizure effected; pending.
106	Thomas Massey & Co.	Pennsylvania, eastern district.	100 cases of adulterated and misbranded whisky shipped from Michigan to Pennsylvania.	Libel filed; seizure effected; answer filed; pending.
108	S. Rosenbloom & Co.	Pennsylvania, western district.	50 cases of adulterated and misbranded whisky shipped from Michigan to Pennsylvania.	Do.
115	Knowlton Danderine Co.	West Virginia, northern district.	65 casks of misbranded drug shipped from Michigan to West Virginia.	Judgment for claimant; Government's appeal pending.
140	Maude Yale Bishop Wilson (Mme. Yale).	District of Columbia.	85 dozen packages of misbranded drugs shipped from New York to the District of Columbia.	Decree of condemnation and forfeiture rendered.
143	McCord-Collins Mercantile Co.	Oklahoma, western district.	678 cases of misbranded canned corn shipped from Iowa to Oklahoma.	Do.
144	W. C. Early Co...	Tennessee, western district.	1,656 cases of adulterated and misbranded canned molasses shipped from Louisiana to Tennessee.	Do.
147	Morrison Hinton Grocery Co.	Mississippi, northern district.	40 barrels of misbranded blackberry senoj and 38 barrels of misbranded vinegar shipped from Kentucky to Mississippi.	Libel filed; seizure effected; pending.
148	J. S. Ogburn & Co.	Oklahoma, western district.	797 boxes of misbranded canned blackberries shipped from Texas to Oklahoma.	Decree of condemnation and forfeiture rendered.
149	Spencer & Howes..	Michigan, eastern district.	276 tubs of adulterated eggs shipped from Ohio to Michigan.	Do.
150	The Winter Loeb Grocery Co.	Alabama, middle district.	40 cases of adulterated and misbranded coffee shipped from Louisiana to Alabama.	Libel filed; seizure effected; goods released on bond without decree.
151	Ratcliff, Sanders Grocery Co.	Oklahoma, eastern district.	30 cases of misbranded canned cherries shipped from Michigan to Oklahoma.	Decree of condemnation and forfeiture rendered.
153 154	C. E. Coe.........	Arkansas, eastern district.	779 cases of misbranded molasses shipped from Tennessee to Arkansas.	Verdict for claimant; Government's appeal pending.
155	J. J. Pierson	Kansas...........	340 cases of misbranded canned tomatoes shipped from Missouri to Kansas.	Decree of condemnation and forfeiture rendered.
158	Smith - Yingling Co.	Tennessee, western district.	800 cases of misbranded canned corn shipped from Maryland to Tennessee.	Do.

Cases under section 10 of the food and drugs act of June 30, 1906, reported during the fiscal years 1908 and 1909 and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Claimant.	Judicial district.	Subject of offense.	Disposition or present status of case.
163	Wichita Wholesale Grocery Co.	Kansas	285 cases of misbranded canned tomatoes and 395 cases of misbranded canned peas shipped from Indiana to Kansas.	Decree of condemnation and forfeiture rendered.
169	Ranney-Davis Mercantile Co.	do	325 cases of misbranded canned corn shipped from Iowa to Kansas.	Do.
170	John Cuthrell	Virginia, eastern district.	400 sacks of misbranded meal shipped from Kentucky to Virginia.	Do.
171	J. B. A. Kern & Sons.	Ohio, northern district.	1 carload of misbranded rye flour shipped from Wisconsin to Ohio.	Do.
172	H. P. Harrison & Co.	Virginia, eastern district.	25 barrels of misbranded distilled vinegar shipped from Maryland to Virginia.	Do.
173	Shields-Morley Grocery Co.	Colorado	450 cases of misbranded maple sirup shipped from Illinois to Colorado.	Do.
174	Joseph A. Goddard & Co.	Indiana	70 cases of misbranded canned apples shipped from Ohio to Indiana.	Do.
175	N. H. Shea et al	District of Columbia.	109 cases of misbranded drug shipped from Kentucky to the District of Columbia.	Libel filed; seizure effected; pending.
178	F. J. Kiesel & Co.	Utah	1,240 cases of misbranded canned corn shipped from Iowa to Utah.	Decree of condemnation and forfeiture rendered.
179	Hulman & Co.	Indiana	400 cases of misbranded canned apples shipped from New York to Indiana.	Do.
181	Dayton Spice Mills Co.	Pennsylvania, western district.	309 cases of misbranded coffee shipped from Ohio to Pennsylvania.	Do.
183	S. J. Van Lil & Co.	Rhode Island	650 cases of misbranded tomato catsup shipped from Maryland to Massachusetts for sale.	Do.
185	Bement-Ray Co.	Indiana	282 cases of misbranded canned peas shipped from Illinois to Indiana.	Do.
186	J. K. Armsby & Co.	Oklahoma, western district.	478 cases of misbranded canned peaches shipped from California to Oklahoma.	Do.
187	F. S. Fishback	Indiana	200 cases of misbranded coffee shipped from Ohio to Indiana.	Do.
188	Getz Bros	California, northern district.	900 cases of misbranded canned corn shipped from Iowa to California.	Libel filed; seizure effected; pending.
188a	Haas Bros	do	700 cases of misbranded canned corn shipped from Iowa to California.	Do.
189	Great Bear Spring Co.	District of Columbia.	350 cases and 100 demijohns of adulterated mineral water offered for sale in the District of Columbia.	Decree of condemnation and forfeiture rendered.
192	Bierhans Bros	Indiana	40 barrels of misbranded vinegar shipped from Kentucky to Indiana.	Do.
195	N. H. Shea	District of Columbia.	60 cases of adulterated and misbranded malt whisky shipped from New York to the District of Columbia.	Libel filed; seizure effected; pending.
199	Greek Currant Co.	Louisiana, eastern district.	500 cases of misbranded currants shipped from New York to Louisiana.	Decree of condemnation and forfeiture rendered.
200	J. E. Dyer & Co.	District of Columbia.	4 barrels of adulterated and misbranded whisky offered for sale in the District of Columbia.	Do.
201	Bartlett Commission Co.	Tennessee, eastern district.	1 carload of adulterated oats shipped from Illinois to Tennessee.	Do.
205	Brady, Neely Grocery Co.	Texas, northern district.	688 cases of misbranded canned corn shipped from Nebraska to Texas.	Do.
207	C. F. Blanke Tea and Coffee Co.	Pennsylvania, western district.	300 cases of misbranded coffee shipped from Missouri to Pennsylvania.	Do.

Cases under section 10 of the food and drugs act of June 30, 1906, reported during the fiscal years 1908 and 1909 and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Claimant.	Judicial district.	Subject of offense.	Disposition or present status of case.
210	Parrott Co.	California, northern district.	5,000 cases of misbranded canned pineapples shipped from Hawaii to California.	Libel filed; seizure effected; pending.
211	Van Camp Packing Co.	Ohio, southern district.	900 cases of misbranded canned peas shipped from Indiana to Ohio.	Decree of condemnation and forfeiture rendered.
212	.....do	Kentucky, eastern district.	200 cases of misbranded canned peas shipped from Indiana to Kentucky.	Do.
219	Otis H. Wood	District of Columbia.	75 bottles of adulterated and misbranded mineral water offered for sale in the District of Columbia.	Do.
233	H. F. Allen	California, northern district.	1,000 sacks of misbranded flour shipped from Oregon to California.	Libel filed; seizure effected; pending.
234	C. A. Hutton Flour Co.	.....do	300 sacks of misbranded flour shipped from Oregon to California.	Do.
235	MacLaren Imperial Cheese Co.	District of Columbia.	42 cases of adulterated cheese shipped from Michigan to the District of Columbia.	Do.
240	Alois Rytina	Illinois, northern district.	280 sacks of adulterated and misbranded flour shipped from Wisconsin to Illinois.	Decree of condemnation and forfeiture rendered.
246	Kohlmeyer, Jacobs & Hyams Co. (Ltd.).	Louisiana, eastern district.	12 barrels of misbranded whisky shipped from Pennsylvania to Louisiana.	Do.
247	Githens, Rexamer & Co.	Pennsylvania, eastern district.	375 packages of misbranded cheese shipped from New York to Pennsylvania.	Do.
254	Spratlen-Anderson Mercantile Co.	Colorado	100 cases of misbranded canned cherries shipped from Utah to Colorado.	Do.
255	E. R. Pahl & Co.	Tennessee, eastern district.	20 cases of misbranded honey shipped from Wisconsin to Tennessee.	Do.
256	Climax Coffee and Baking Powder Co.	Ohio, southern district.	16 cases of misbranded coffee shipped from Indiana to Ohio.	Do.
257	.....do	.....do	17 cases of misbranded coffee shipped from Indiana to Ohio.	Do.
258	.....do	.....do	27 cases of misbranded coffee shipped from Indiana to Ohio.	Do.
261	Fox River Butter Co.	.....do	13 boxes of misbranded butter shipped from Wisconsin to Ohio.	Do.
271	MacLaren Imperial Cheese Co.	Pennsylvania, eastern district.	85 cases of adulterated cheese shipped from Maryland to Pennsylvania.	Libel filed; seizure effected; pending.
273	Crescent Manufacturing Co.	Illinois, northern district.	300 cases of misbranded "Mapleine" shipped from Washington to Illinois.	Jury trial; verdict for the Government; decree of condemnation and forfeiture rendered.
279	Louis Pfister	Louisiana, eastern district.	20 cases of misbranded butter shipped from Illinois to Louisiana.	Decree of condemnation and forfeiture rendered.
284	H. A. Thierman & Co.	Indiana	5 barrels of misbranded whisky (Prairie Flower whisky) shipped from Kentucky to Indiana.	Do.
285	Quinine Whiskey Co.	Illinois, northern district.	10 cases of misbranded whisky (Quinine whisky) shipped from Kentucky to Illinois.	Do.
287	Lee, Cady & Smart	Michigan, eastern district.	50 cases of misbranded "Mapleine" shipped from Ohio to Michigan.	Libel filed; seizure effected; pending.
287a	C. Elliott & Co.	.....do	16 cases of misbranded "Mapleine" shipped from Ohio to Michigan.	Do.
289	Chas. Foehney	Louisiana, eastern district.	11 barrels of misbranded whisky shipped from Virginia to Louisiana.	Decree of condemnation and forfeiture rendered.
296	F. Hollander & Co.	.....do	10 barrels of misbranded whisky shipped from Pennsylvania to Louisiana.	Libel filed; seizure effected; answer filed; pending.

Cases under section 10 of the food and drugs act of June 30, 1906, reported during the fiscal years 1908 and 1909 and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Claimant.	Judicial district.	Subject of offense.	Disposition or present status of case.
297	Julius Groetsch	Louisiana, eastern district.	20 barrels of misbranded whisky shipped from Maryland to Louisiana.	Decree of condemnation and forfeiture rendered.
303	Ross & Co	do	5 barrels of misbranded whisky shipped from Maryland to Louisiana.	Do.
304	MacLaren Imperial Cheese Co.	Illinois, northern district.	30 cases of misbranded cheese shipped from Michigan to Illinois.	Do.
325	Baltimore Manufacturing Co.	Virginia, eastern district.	75 barrels of misbranded vinegar shipped from Maryland to Virginia.	Do.
325a	do	do	15 barrels of misbranded vinegar shipped from Maryland to Virginia.	Do.
326	Geo. Bubb & Sons.	Pennsylvania, middle district.	15 barrels of misbranded sirup shipped from Illinois to Pennsylvania.	Do.
327	MacLaren Imperial Cheese Co.	Illinois, northern district.	25 cases of misbranded cheese shipped from Michigan to Illinois.	Do.
328	Southern Manufacturing Co.	Louisiana, eastern district.	501 cases of misbranded baking powder shipped from Virginia to Louisiana.	Do.
329	D. R. Wilder Manufacturing Co.	Mississippi, southern district.	44 cases of misbranded sirup shipped from Georgia to Mississippi.	Do.
330	Plummer Mercantile Co.	Colorado	400 cases of misbranded canned corn shipped from Nebraska to Colorado.	Do.
337	E. M. Sheetz	District of Columbia.	150 pails of misbranded maple sugar shipped from New York to the District of Columbia.	Do.
343	Baird Bros	North Carolina, western district.	50 packages of misbranded cheese shipped from Illinois to North Carolina.	Do.
343a	Mustin-Robertson Co.	do	10 packages of misbranded cheese shipped from Illinois to North Carolina.	Do.
344	L. Kahn	Texas, eastern district.	57 cases of misbranded evaporated apples shipped from Louisiana to Texas.	Do.
352	Western Reserve Syrup Co.	Illinois, eastern district.	68 cases of adulterated and misbranded maple sirup shipped from Ohio to Illinois.	Libel filed; seizure effected; demurrer filed; pending.
420	Witwer Bros	Iowa, northern district.	150 cases of misbranded canned fruit shipped from California to Iowa.	Decree of condemnation and forfeiture rendered.
421	No claimant	Vermont	2 drums of adulterated turpentine shipped from Ohio to Vermont.	Decree of condemnation, forfeiture, and sale rendered.
425	J. F. Humphreys & Co.	Illinois, southern district.	300 cases of misbranded canned peas shipped from Wisconsin to Illinois.	Decree of condemnation and forfeiture rendered.
426	Henkel-Duke Co	Colorado	135 cases of misbranded canned tomatoes shipped from Utah to Colorado.	Do.
427	Morral Canning Co.	Indiana	737 cases of misbranded canned corn shipped from Ohio to Indiana.	Do.
430	F. T. Gunther Grocery Co.	Kentucky, western district.	800 cases of misbranded canned corn shipped from Indiana to Kentucky.	Do.
433	Atlantic Canning Co.	Texas, western district.	430 cases of misbranded canned corn shipped from Iowa to Texas.	Do.
447	Smith Bros. & Burdeck Co.	Iowa, southern district.	900 cases of misbranded canned peas shipped from Wisconsin to Iowa	Libel filed: seizure effected; pending.
448	Reno Grocer Co	Nevada	54 cases of misbranded canned shrimp shipped from Louisiana to Nevada.	Do.
449	Ridenour-Baker-Bragdon Mercantile Co.	Colorado	136 cases of misbranded canned tomatoes shipped from Utah to Colorado.	Decree of condemnation and forfeiture rendered.
450	Ritchie & Co	Arkansas, western district.	26 barrels of misbranded vinegar shipped from Kentucky to Arkansas.	Libel filed: seizure effected; pending.

Cases under section 10 of the food and drugs act of June 30, 1906, reported during the fiscal years 1908 and 1909 and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Claimant.	Judicial district.	Subject of offense.	Disposition or present status of case.
451	Joseph Speidel Grocery Co.	West Virginia, northern district.	80 barrels of misbranded vinegar shipped from Ohio to West Virginia.	Libel filed; seizure effected; pending.
452	Cochran Grocery Co.	Oklahoma, eastern district.	471 cases of misbranded canned peaches shipped from California to Oklahoma.	Decree of condemnation and forfeiture rendered.
460	Shryack Thom Grocery Co.	Missouri, eastern district.	110 cases of misbranded canned corn shipped from Iowa to Missouri.	Do.
468	Muskogee Wholesale Grocer Co.	Oklahoma, eastern district.	63 cases of misbranded canned beans shipped from Wisconsin to Oklahoma.	Do.
469	Banker & Co.	New York, northern district.	180 cases of misbranded canned blueberries shipped from Maine to New York.	Do.
469a	do	do	500 cases of misbranded canned blueberries shipped from Maine to New York.	Do.
474	Hudson & Thompson.	Alabama, middle district.	1 carload of adulterated and misbranded stock feed shipped from Illinois to Alabama.	Libel filed; seizure effected; pending.
478	B. S. Snow & Co.	Massachusetts	150 cases of misbranded canned blueberries shipped from Maine to Massachusetts.	Do.
487	Consolidated Grocery Co.	Florida, northern district.	420 cases of misbranded canned baking powder shipped from Tennessee to Florida.	Decree of condemnation and forfeiture rendered.
492	E. P. Daily	Pennsylvania, middle district.	200 sacks of adulterated and misbranded flour middlings shipped from New York to Pennsylvania.	Do.
500	Hipolite Egg Co.	Illinois, southern district.	50 cases of adulterated eggs shipped from Missouri to Illinois.	Libel filed; seizure effected; pending.
501	Musolino & Berger.	Massachusetts	2 barrels of misbranded olive oil shipped from Pennsylvania to Massachusetts.	Do.
508	S. H. Beiler Grocery Co.	Missouri, western district.	78 cases of misbranded canned sirup shipped from Illinois to Missouri.	Do.
509	Neill Grocery Co.	West Virginia, northern district.	68 barrels of misbranded vinegar shipped from Michigan to West Virginia.	Decree of condemnation, forfeiture, and destruction rendered.
522	Henke & Pilot	Texas, southern district.	506 cases of misbranded preserves shipped from Maryland to Texas.	Decree of condemnation and forfeiture rendered.
523	W. S. Henderson	Utah	54 cases of misbranded blueberries shipped from New York to Utah.	Do.
525	W. C. Brewer & Co.	North Carolina, eastern district.	320 barrels of misbranded flour shipped from Virginia to North Carolina.	Do.
528	L. & J. Spiegel	Georgia, northern district.	3 cases of misbranded beaver oil shipped from New York to Georgia.	Libel filed, seizure effected; pending.
529	Acme Mills Co	California, southern district.	500 sacks of adulterated rolled oats shipped from Oregon to California.	Decree of condemnation and forfeiture rendered.
537	A. E. Beitzel	District of Columbia.	10 cases of misbranded "Buchu gin" shipped from New York to the District of Columbia and held for sale in said District.	Libel filed; seizure effected; pending.
538	Lawrence & Hamilton Feed Co.	Georgia, northern district.	200 bags of adulterated and misbranded "Stafolife" stock feed shipped from Louisiana to Georgia.	Decree of condemnation and forfeiture rendered.
539	Farrell & Co.	Colorado	50 cases of misbranded sirup shipped from Nebraska to Colorado.	Do.
540	Wm. Numsen & Son.	Texas, western district.	190 cases of misbranded preserves shipped from Maryland to Texas.	Do.
544	Corn Products Refining Co.	Ohio, southern district.	46 packages of adulterated and misbranded sugar shipped from Illinois to Ohio.	Libel filed; seizure effected; answer filed; pending.
546	Oakland Vinegar and Pickle Co.	Ohio, northern district.	25 barrels of adulterated and misbranded vinegar shipped from Michigan to Ohio.	Libel filed; siezure effected; pending.

Cases under section 10 of the food and drugs act of June 30, 1906, reported during the fiscal years 1908 and 1909 and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Claimant.	Judicial district.	Subject of offense.	Disposition or present status of case.
553	H. C. Draper & Co.	Georgia, southern district.	200 sacks of adulterated and misbranded stock feed shipped from Illinois to Georgia.	Libel filed; seizure effected; pending.
554	J. M. Ellis Sons Co.	Alabama, middle district.	100 sacks of adulterated oats shipped from Tennessee to Alabama.	Libel filed; goods disposed of before writ of attachment could be executed.
555	No claimant	.....do	26 barrels of misbranded vinegar shipped from Kentucky to Alabama.	Libel filed; seizure effected; pending.
563	J. Lindsay Wells Co.	Indiana	600 sacks of adulterated and misbranded cotton-seed meal shipped from Tennessee to Indiana.	Decree of condemnation and forfeiture rendered.
573	Prescription Products Co.	Ohio, southern district.	8 casks of misbranded drugs shipped from Michigan to Ohio.	Libel filed; seizure effected; demurrer filed; pending.
574	Gross, Kelly & Co.	New Mexico	46 cases of misbranded sirup shipped from Nebraska to New Mexico.	Libel filed; seizure effected; pending.
575	Reeves, Parvin & Co.	Pennsylvania, eastern district.	113 cases of misbranded canned pineapples shipped from New York to Pennsylvania.	Decree of condemnation and forfeiture rendered.
576	Meyer Bros. Drug Co.	Missouri, eastern district.	50 jugs of adulterated and misbranded cherry sirup shipped from Ohio to Missouri.	Do.
577	James Hunter	Idaho	150 cases of misbranded canned corn shipped from Nebraska to Idaho.	Do.
579	Provident Chemical Works.	California, northern district.	100 barrels of adulterated and misbranded calcium acid phosphate shipped from Missouri to California.	Libel filed; seizure effected; claimant answered denying adulteration and misbranding; court sustained answer and dismissed libel.
580	Woodrow & Lewis.	New York, southern district.	400 cases of misbranded cans of baking powder shipped from Pennsylvania to New York.	Libel filed; seizure effected; pending.
581	J. K. Armsby Co..	Washington, western district.	100 cases of misbranded canned apricots shipped from California to Washington.	Decree of condemnation and forfeiture rendered.
587	No claimant	Missouri, eastern district.	46 barrels of adulterated and misbranded vinegar shipped from Ohio to Missouri.	Libel filed; marshal returned "not found."
588	Goddard Grocery Co.	.....do	42 barrels of adulterated and misbranded vinegar shipped from Ohio to Missouri.	Libel filed; seizure effected; pending.
589	N. Dewald & Co....	Georgia, southern district.	350 sacks of adulterated "Banner Feed" shipped from Maryland to Georgia.	Decree of condemnation and forfeiture rendered.
590	S. H. Levin's Sons.	Pennsylvania, eastern district.	2,300 cases of misbranded canned tomatoes shipped from Delaware to Pennsylvania.	Do.
595	C. Sheuerman	Colorado	52 cases of misbranded wine shipped from California to Colorado.	Do.
596	French Lick Springs Hotel Co.	Maryland	34 cases of misbranded mineral water shipped from Indiana to Maryland.	Do.
597	L. A. Miller & Son.	Florida, southern district.	1,500 sacks of adulterated and misbranded oats shipped from Pennsylvania to Florida.	Do.
598	Libby, McNeill & Libby.	Illinois, northern district.	38 barrels of adulterated and misbranded vinegar shipped from Ohio to Illinois.	Libel filed; seizure effected; pending.
599	J. H. Schell	Washington, western district.	25 cases of misbranded "Radam's Microbe Killer" shipped from California to Washington.	Do.
600	The Tennessee Fiber Co.	North Carolina, western district.	120 sacks of adulterated and misbranded cotton-seed meal shipped from Tennessee to North Carolina.	Do.

Cases under section 10 of the food and drugs act of June 30, 1906, reported during the fiscal years 1908 and 1909 and finally determined during the latter year or pending in the courts at its close—Continued.

F. & D. case No.	Claimant.	Judicial district.	Subject of offense.	Disposition or present status of case.
601	Bradfield Regulator Co.	Louisiana, eastern district.	52 cases of misbranded "Mother's Friend" shipped from Georgia to Louisiana.	Decree of condemnation and forfeiture rendered.
602	.....do..............	Missouri, eastern district.	57 cases of misbranded "Mother's Friend" shipped from Georgia to Missouri.	Libel filed; seizure effected; pending.
603	No claimant......	District of Columbia.	12 cases of misbranded "Radam's Microbe Killer" shipped from New York to the District of Columbia and held for sale therein.	Do.
604	Philip G. Affleck..	.....do............	2½ gross of misbranded "Make-Man Tablets" held and offered for sale in the District of Columbia.	Do.
606	I. R. Howard & Co.	Indiana...........	200 cases of misbranded canned apricots shipped from California to Indiana.	Decree of condemnation and forfeiture rendered.
614	No claimant......	Maryland..........	200 sacks of adulterated and misbranded "Mueller's Molasses Grains" shipped from Virginia to Maryland.	Libel filed; seizure effected; pending.
615	Bradfield Regulator Co.	Missouri, eastern district.	36 cases of misbranded "Mother's Friend" shipped from Georgia to Missouri.	Do.
624	Libby, McNeill & Libby.	Louisiana, eastern district.	200 cases of misbranded condensed milk shipped from Illinois to Louisiana.	Decree of condemnation and forfeiture rendered.
631	Alabama-Georgia Syrup Co.	Tennessee, western district.	358 cases of misbranded sirup shipped from Alabama to Tennessee.	Do.
633	S. Peterson & Co..	Illinois, northern district.	23 barrels of adulterated and misbranded vinegar shipped from Ohio to Illinois.	Libel filed; seizure effected; pending.

In addition to the foregoing cases reported direct by the Department to the Attorney-General or to the United States attorneys, there were a number of cases reported to the United States attorneys under the provisions of section 5 of the act, by local health, food, or drug officers of the States and the District of Columbia, acting under appointment for that purpose by the Secretary of Agriculture. Those of the cases so reported which were finally determined during the year are given in the appended tables.

Cases under section 2 of the food and drugs act of June 30, 1906, reported to United States attorneys by collaborators of the Department and finally determined during the fiscal year 1909.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition of the case.
1C	Howard Griffith...	District of Columbia.	Sale in the District of Columbia of milk adulterated with water.	Defendant pleaded guilty; fined $25.
2C	John Allen........	.....do............	.....do......................	Defendant pleaded guilty; fined $10.
3C	Chas. M. Carney...	.....do............	.....do......................	Defendant acquitted.
4C	Albert Schapiro...	.....do............	.....do......................	Defendant convicted; fined $20.
5C	Philip Hettenkemer.	.....do............	.....do......................	Defendant forfeited collateral security, $10.
6C	Geo. A. Wise......	.....do............	.....do......................	Defendant pleaded guilty; fined $20.
7C	Frank E. Altemus.	.....do............	.....do......................	Defendant forfeited collateral security, $20.
8C	Patrick B. Holt...	.....do............	.....do......................	Defendant convicted; fined $10.

Cases under section 2 of the food and drugs act of June 30, 1906, reported to United States attorneys by collaborators of the Department and finally determined during the fiscal year 1909—Continued.

F. & D. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition of the case.
9C	William W. Whitehead.	District of Columbia.	Sale in the District of Columbia of milk adulterated with water.	Defendant forfeited collateral security, $5.
10C	Wm. A. Sanger	do	do	Do.
11C	Soul Berman	do	do	Do.
12C	Chas. E. Vernon	do	do	Do.
13C	Chas. Harbin	do	do	Do.
14C	Frank Mace	do	do	Do.
15C	Julia Poore	do	do	Defendant pleaded guilty; fined $25.
16C	Grover F. Jarboe	do	do	Defendant forfeited collateral security, $5.
17C	Blanche D. Siddall	do	do	Do.
18C	Seraphim A. Gatti	do	Sale in the District of Columbia of misbranded lemon extract.	Defendant pleaded guilty; fined $30.
23C	Heim Brewing Co.	Kansas	Shipment of misbranded beer from Missouri to Kansas.	Defendant pleaded guilty; fined $100.
25C	Samuel Cohen	Pennsylvania, eastern district.	Shipment of 9,000 adulterated eggs from Pennsylvania to New York.	Defendant pleaded guilty; fined $50 and costs, $51.68.

Cases under section 10 of the food and drugs act of June 30, 1906, reported to United States attorneys by collaborators of the Department and finally determined during the fiscal year 1909.

F. & D. case No.	Claimant.	Judicial district.	Subject of offense.	Disposition of the case.
19C	Alex C. Harsh & Co.	Georgia, northern district.	200 bags of adulterated oats shipped from Tennessee to Georgia.	Decree of condemnation and forfeiture rendered.
20C	E. G. Dailey Co.	Indiana	42 cases of misbranded canned baked beans shipped from Michigan to Indiana.	Do.
21C	Sears & Nichols Co.	do	34 cases of misbranded canned tomatoes shipped from Ohio to Indiana.	Do.
22C	Hessig-Ellis Drug Co.	Kansas	41 boxes of misbranded drug (Muco-Solvent) shipped from Tennessee to Kansas.	Do.
24C	No claimant	Pennsylvania, eastern district.	9,000 adulterated eggs delivered for shipment from Pennsylvania to New York.	Do.
26C	John Wade & Sons	Georgia, southern district.	300 sacks of adulterated oats shipped from Tennessee to Georgia.	Do.
27C	P. P. Williams Grain Co.	do	400 sacks of adulterated and misbranded oats shipped from Missouri to Georgia.	Do.
28C	Central National Bank of St. Louis, Mo.	do	250 sacks of adulterated oats shipped from Missouri to Georgia.	Do.

There were reported during the year four cases of breaches of conditions of bonds filed by claimants of goods condemned and forfeited to the United States and subsequently released to them under the provisions of section 10 of the act. Demurrers and answers were filed by the obligors, and the cases were not at issue at the close of the year. The cases are as follows:

Suits for breach of conditions of bonds filed by claimants in proceedings under section 10 of the food and drugs act of June 30, 1906, pending at the close of the fiscal year 1909.

Case No.	Obligor.	Judicial district.	Cause of action.	Status of case on June 30, 1909.
23a	J. G. Dorn and Thos. F. Cunningham.	Louisiana, eastern district.	Disposing of wine previously condemned for adulteration and misbranding, in violation of terms of bond filed by claimant to secure its redelivery to him.	Declaration filed; demurrer thereto pending.
23b	The A. Schmidt, jr. & Bros. Wine Co. and Alfred E. Morphy.	.....do.............	.....do.......................	Declaration filed; answer filed; pending.
94	Fox River Butter Co., principal, and S. M. Richardson and A. J. Becht, sureties.	Ohio, southern district.	Disposing of butter previously condemned for misbranding, in violation of terms of bond filed by claimant to secure redelivery to it.	Declaration filed; demurrer thereto pending.
97	Climax Coffee and Baking Powder Co. and American Surety Co.	.....do.............	Disposing of coffee previously condemned for misbranding, in violation of terms of bond filed by claimant to secure redelivery to it.	Declaration filed; pending.

NOTICES OF JUDGMENT.

In addition to the work incident to the preparation of the foregoing cases and the subsequent correspondence in reference thereto, the Solicitor assisted in drafting and correcting for publication 66 notices of judgment, provided for by section 4 of the food and drugs act, published during the year. The demand for these notices is very great, and it is apparent that manufacturers and dealers are closely watching the operation of the law. It is the publication of these that operates to deter many who would otherwise take the chances of the mere payment of a fine. It may be added that, as a member of the Board of Food and Drug Inspection, much of the time of the Solicitor during the year was consumed in attendance on the almost daily hearings held before the board and in the voluminous correspondence of the board.

THE TWENTY-EIGHT HOUR LAW.

PROGRESS IN ENFORCEMENT OF THE ACT.

The efficacy of a law designed to correct public evils depends almost wholly upon the vigor of its enforcement. By this token the twenty-eight hour law is a conspicuous success, as will be demonstrated by a simple comparison of the number of cases reported for prosecution to the Attorney-General during the preceding fiscal year and the one just closed, for it is by the decrease in the number of violations of a law that its success in the accomplishment of the purposes for which it is designed must be tested. During the former year 685 cases were reported for prosecution, while during the latter, with an equal degree of activity and vigilance in the ascertainment of violations, only 208 cases were reported, a decrease of 477 cases, or 70 per cent. In the brief period of three years from the inception of active and determined preparations by the Department to compel compliance with this act by proceedings in the courts, violations reported for prosecution reached the startling figure of 685 in a single year, and decreased to 208 in the succeeding year.

At the close of the preceding fiscal year 828 cases were pending in the courts. Of these, together with part of those reported during the present fiscal year, 617 were determined in favor of the Government and resulted in the collection of penalties to the amount of $73,490 and costs aggregating $11,539.85, an increase in penalties and costs over the previous year of $11,960 and $4,338.14, respectively. A statistical and explanatory table of these cases is inserted on page 765. Only 33 cases, or about 5 per cent, resulted adversely to the Government. Eighty-one cases were abandoned because of lack of sufficient evidence to maintain them. There were pending in the courts at the close of the present fiscal year 305 cases, a substantial part of which, it is obvious, were cases reported in previous years and remaining undisposed of on account of appeals and other dilatory causes.

It must be apparent from the insignificant percentage of cases lost by the Government that the United States attorneys have fully and effectively performed their part in the enforcement of this law. The cordial cooperation between the Department and the United States attorneys which has marked previous years has been maintained without exception during the year just closed. Assistance has been rendered them by this Office in innumerable instances and particulars, and their compliance with suggestions and requests has been considerate, courteous, and prompt.

From what has preceded it is plain that the railroads are now complying in an appreciable measure with the requirements of the act. It is too much to expect, for the present at least, that offenses will entirely cease, but it may be confidently predicted that in the course of the next few years substantial compliance with both the letter and the spirit of the law will prevail.

DECISIONS OF THE COURTS.

During the last fiscal year, as stated in the report of this Office, the much mooted, vexatious, and important question of what constituted the unit of violation of the act was practically settled by the decision of the Circuit Court of Appeals for the sixth circuit in the case of the United States *v.* Baltimore and Ohio Southwestern Railroad Company (159 Fed., 33), wherein it was decided that each separate shipment confined in violation of the act constitutes an offense. This construction of the act was reaffirmed during the present fiscal year in the Circuit Court of Appeals for the first circuit (New York Central and Hudson River Railroad Company *v.* United States, 165 Fed., 833, Circular No. 15 of this Office); in the Circuit Court of Appeals for the second circuit (United States *v.* New York, Chicago and St. Louis Railroad Company, 168 Fed., 699, Circular No. 16 of this Office); and in the Circuit Court for the district of Oregon (United States *v.* Oregon Railway and Navigation Company, 163 Fed., 642, Circular No. 8 of this Office). So, it may be considered as finally settled that the basis for imposition of penalties under the act, as maintained from the outset by the Department, is the shipment, and that the carrier is liable for as many separate penalties as there are independent shipments in the train.

Another important question decided by the Circuit Court of Appeals in the above-stated case of United States *v.* Baltimore and

Ohio Southwestern Railroad Company during the last fiscal year, namely, that the United States are entitled to a writ of error to review an adverse judgment in actions under this act, found its reiteration and approval during the present year by the Circuit Court of Appeals for the second circuit in the case of the United States *v.* New York, Chicago and St. Louis Railroad Company, 168 Fed., 699, Circular No. 16 of this Office.

The right to a writ of error in actions under this act has been of substantial value during the present year, for in two districts the decisions in the lower courts on important and vital questions, such as the unit of violation and the defense of press of business and congestion of traffic, were adverse to the United States, but were overruled in the appellate courts. United States *v.* Union Pacific Railroad Company, 169 Fed., 65, Circular No. 14 of this Office; and United States *v.* New York, Chicago and St. Louis Railroad Company, 168 Fed., 699, Circular No. 16 of this Office.

A related principle, in fact the basic one upon which the right of the United States to a writ of error to review adverse decisions under this act depends and which the railroads have strenuously contested and the Department as strenuously asserted, namely, that suits to recover the penalties prescribed by the twenty-eight hour law are civil actions to which the rules of civil pleading and evidence apply, and are not criminal, was sustained in several judicial districts near the close of the last fiscal year and during the present in the following reported cases: United States *v.* Colorado and Southern Railway Company (Colorado), Circular No. 7 of this Office; United States *v.* Southern Pacific Company (California, northern district), 162 Fed., 412, Circular No. 9 of this Office; Montana Central Railway Company *v.* United States (Montana Circuit Court of Appeals, ninth circuit), 164 Fed., 400, Circular No. 12 of this Office; New York Central and Hudson River Railroad Company *v.* United States (Massachusetts Circuit Court of Appeals, first circuit), 165 Fed., 833, Circular No. 15 of this Office; and United States *v.* New York, Chicago and St. Louis Railroad Company (New York Circuit Court of Appeals, western district, second circuit), 168 Fed., 699, Circular No. 16 of this Office.

As a sequel to this principle, it was held in four reported cases that the United States are not required to prove offenses under the act beyond a reasonable doubt, but only by a preponderance of evidence. United States *v.* Colorado and Southern Railway Company (Colorado), Circular No. 7 of this Office; United States *v.* Southern Pacific Company (California, northern district), 162 Fed., 412, Circular No. 9 of this Office; United States *v.* Fort Worth Belt Railway Company (Texas, northern district), Circular No. 11 of this Office; and New York Central and Hudson River Railroad Company *v.* United States (Massachusetts Circuit Court of Appeals, first circuit), 165 Fed., 833, Circular No. 15 of this Office.

As stated in the last report of this Office, the railroads were relying with considerable confidence and encouragement on the words "knowingly" and "willfully" in section 3 of the act, contending that they must be construed in the same sense in which they are ordinarily employed in criminal law, and that, therefore, in order to establish the offense the United States must show that it was committed with a bad or evil intent, or at all events, with a specific intent to violate the law. While the contention has been widely and vigorously urged, and at times with vehemence, it has not met with favor in the courts, they rather adopting the view that a carrier knowingly violates the act when it confines animals in its possession beyond the statutory time with ample facilities at its command to know or ascertain, but does not, when the animals were last unloaded for feed, rest, and water, how long they have already been confined when delivered to it by a connecting carrier, or at what time they are originally loaded into their own cars, and other facts in reference thereto, and that a carrier willfully violates the act when it has the facilities to know and ascertain these facts, but in indifferent disregard to them and with intention to keep the animals in the cars for the time it does so, confines them beyond the statutory time.

A clear and convincing exposition of the reasonable and sensible interpretation of these words is contained in Judge Lewis's charge to the jury in the case of the United States *v.* Colorado and Southern Railway Company, referred to above in another connection, wherein he said:

> It is the duty of the railroad company that receives a shipment from another to use reasonable diligence in ascertaining when the live stock was put in the cars and whether or not it had been unloaded, and if unloaded before reaching the receiving carrier, how long before. The testimony shows that these sheep were not unloaded from the time they were first received in Wyoming. If the defendant company, its agents, and servants who had charge of these shipments, knew that, or by the exercise of reasonable inquiry on their part could have ascertained the hour at which these sheep were loaded, and that they had not been unloaded up to the time the cars came into their possession, then they had knowledge of the facts. One is charged with knowledge not only of what he specifically and certainly knows, but what he might find out by reasonable inquiry. He is charged not only with knowledge of specific facts that come to his personal observation, but with such facts as by reasonable inquiry it is his duty to attempt to ascertain, whether he ascertains them or not, and, therefore, if the defendant company knew, or could by the exercise of reasonable inquiry have ascertained, that these sheep had not been unloaded from the time they were first put upon the cars, at 5.15 p. m., October 3, then it had knowledge of the fact, and its failure thereafter to comply with the statute, if it did fail, was a willful failure, and you should find a verdict against the defendant.

In full accord with the above charge of Judge Lewis was the language of Judge Meek, of the northern district of Texas, in the case of the United States *v.* Fort Worth Belt Railway Company, where, in his instructions to the jury, he said:

> The word "knowingly," as here used, implies that the railroad of whose default the expression is used either knew of the fact that the hogs had not been unloaded for rest, feed, and water within the prescribed time, or had means of knowledge of which it was bound to avail itself and which if followed by diligent inquiry would have brought the fact home to it. The word "willful" as here used implies that the defendant was a free agent and that what it did arose from the spontaneous action of its will, that it knew what it was doing, and intended to do what it did do. It was the duty of the railroad company, holding itself out, as it did, to transport this shipment of live stock from the terminus of the Chicago, Rock Island and Gulf Railway to the Fort Worth stock yards, to know when such shipments were delivered to it for the purpose of such transportation, and to use reasonable diligence in ascertaining how long the live stock had been on the cars without unloading for rest, feed, and water. The evidence shows that these hogs had not been unloaded since they were first put on the cars at Foss, Okla. If the defendant company, through its agents and servants, who should have been in charge of this shipment, knew this fact, or by the exercise of reasonable diligence in making inquiry could have ascertained this fact through the means of communication which were at hand for that purpose, then you are charged that they had knowledge of the fact. One is charged with knowledge not only of specific and certain things, but also with knowledge of what he might find out by reasonable diligence in making inquiry; he is charged not only with the knowledge of specific facts that come to his personal observation, but with such facts as by reasonable inquiry it is his duty to ascertain, whether he ascertains them or not, and, there-

fore, if the defendant company knew, or by the exercise of reasonable diligence in making inquiry could have ascertained, that the hogs had not been unloaded from the time they were first put upon the cars at 4 o'clock p. m., April 27, then it will be held to have had knowledge of the fact, and its failure to comply with the statute, if it did fail, must be held to have been a willful failure, and it will be your duty to find a verdict against the defendant.

Section 1 of the act provides that in estimating the time of unlawful confinement of animals the time during which they have been confined without food, rest, or water on connecting roads shall be included, it being the intent of the act to prohibit their continuous confinement beyond the period of twenty-eight hours except upon the contingencies theretofore stated in the section, which are storms or other accidents or unavoidable causes which can not be anticipated or avoided by the exercise of due diligence and foresight, and the request of the owner or custodian of the animals that the time of confinement be extended to thirty-six hours. Notwithstanding this plain and positive language, which is susceptible of but one interpretation, namely, that in order to avoid a violation of the act connecting carriers must ascertain the time the animals have been confined on previous roads, the contention has been made, and in one case successfully, that in order to maintain a suit against a connecting carrier the United States must show that it had actual knowledge of this time and that this knowledge must be communicated to it by some act of the previous carrier, such as a notation on the waybill or like paper accompanying the shipment. The fallacy of such a contention is apparent when an attentive reading of the whole statute fails to disclose one syllable that imposes upon the previous carrier the duty of advising the connecting carrier of the time the animals have been in its possession or any other facts in reference to them. Except in the one case above referred to, which is now pending on appeal by the United States, the courts have held that it is the duty of the connecting carrier to ascertain for itself how long the animals have been confined by the previous carrier when they are delivered to it, and that if it fails to do so, it can not be heard to say that it committed the offense without knowledge or willfulness. This principle is fully and succinctly stated in the language of Judges Lewis and Meek, quoted above in another connection.

The question of the right of a shipper of animals to file with a carrier a general request for the extension of the time from twenty-eight to thirty-six hours, to cover all future shipments of his, arose in the western district of New York in the last days of the fiscal year in the case of the United States *v.* Pere Marquette Railroad Company (Circular No. 19 of this Office), in which Judge Holt held that the act confers no such right, but that a separate written request must accompany each particular shipment if the owner desires to extend the time.

Early in the year just closed the constitutionality of the act was attacked by demurrer to the complaint in the case of the United States *v.* The Oregon Railroad and Navigation Company (Circular No. 8 of this Office) on the alleged ground that in permitting the owner or custodian of animals to extend the time of confinement from twenty-eight to thirty-six hours it delegated to such owner or custodian legislative power to modify or vary the act at his will. In a very careful and convincing opinion Judge Wolverton overruled the demurrer, and held that the contention was without merit.

The same question was subsequently raised in the Circuit Court of Appeals for the ninth circuit in the case of Southern Pacific Company *v.* United States, reported in 171 Federal Reporter, page 360, in which the court sustained the constitutionality of the act, saying in part:

> A law must be complete in all its terms when it leaves the legislature. But, while a legislature may not delegate the power to legislate, it may delegate the power to determine some fact on which the operation of its own act is made to depend. Although the act in question herein incidentally protects the owners of live stock, its primary and important purpose is to prevent cruelty to animals in transportation. It needs no argument to show how great is the evil which it is intended to remedy. We find no ground for saying that the law as framed by Congress is not complete in itself. No part of it is made by the shipper, nor is he given the option to say that the carrier shall not comply with its provisions. The statute fixes the period of twenty-eight hours as the limit of the time of continuous carriage of live stock without rest, food, and water; but it makes the proviso that the shipper, who is or represents the party in interest, may, if the circumstances seem to him to justify it, extend the time to a period of thirty-six hours. In so providing the law does not give him authority to make that unlawful which otherwise would be lawful.
>
> The delegation of power in this instance is not unlike that which is made by local-option laws, in which the legislature provides that one may not sell liquor in a given place unless the majority of those interested shall by vote grant him the power.

It will be seen from the foregoing decisions of the courts that the avenues of escape for the railroads from the penalties prescribed by this act are exceedingly narrow and restricted, in fact are confined, as provided by the act, to compliance therewith except in those instances where this is rendered impossible through storms or other accidental or unavoidable causes which can not be anticipated or avoided by the exercise of due diligence and foresight. These are the only excuses provided for in the act, and the earlier the railroads acknowledge this and adjust their roads for compliance with the act the earlier will they be relieved of the burden of penalties and court costs.

While the enforcement of the law has resulted in a material abatement of the former cruelty inflicted upon animals by carriers, it is recognized by all who are conversant with conditions surrounding their transportation that the benefits derived from the present law are only partial, and can only be reasonably complete by an amendment to the act requiring carriers to maintain on stock trains an average minimum speed of at least 16 miles an hour, with provision for a lesser speed of 12 miles an hour on those roads which from permanent physical obstacles are unable to maintain the 16-mile rate. At present the carriers comply with the act by frequently unloading the animals, a practice which is attended with unnecessary hardships to the animals and extra expense to the owners, as well as delays in the carriers' own business, all of which could be largely obviated by a greater speed of transportation. By statute, in Nebraska stock trains are required to maintain a minimum rate of 18 miles an hour, with an exception in favor of branch lines of 12 miles an hour. The Supreme Court of that State, in Cram *v.* Chicago, Burlington and Quincy Railroad Company, 122 N. W., 31, has declared the statute constitutional.

Bills have been introduced in two Congresses embodying the 16-mile rate, but no report on them having been made by the committee to whom referred, they have failed of passage. The matter of a minimum speed was fully considered and debated at a recent meeting of the American Humane Society, attended by many stockmen, and it was resolved that such a rate should be required. The president of the society earnestly requested an expression of the views of the Department in reference to the matter, and, accordingly, the Solicitor of the Department, after careful consideration both of the welfare of animals and shippers and the interests of the railroads, submitted to him a memorandum proposing a minimum rate of 16 miles an hour on trains carrying five or more cars of animals, with a provision for the reduction of this rate to 12 miles an hour by the Interstate Commerce Commission when any road, from adverse permanent physical conditions, should show by proof that the 16-mile rate could not be observed on the whole or part of its line. It is believed that such a requirement is both feasible and just, and if embodied in an act of Congress would greatly facilitate the safe and humane transportation of animals which are the subject of interstate commerce.

Statistical summary of suits under the twenty-eight hour law resulting in judgment for the Government during the fiscal year from July 1, 1908, to June 30, 1909.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
522	Atchison, Topeka and Santa Fe	Kansas	$120	....
523 768	....do	....do	240	....
538	....do	....do	200	$27.75
539	....do	....do	250	
595	....do	....do	250	
680	....do	....do	500	63.00
827 859	....do	....do	240	49.15
927 975	....do	....do	240	22.50
1141	....do	....do	120	....
1229	....do	....do	120	....
1392	....do	....do	120	....
1469	....do	....do	100	194.26
1566	....do	....do	100	
1471	....do	....do	450	....
1491	....do	....do	275	....
1528	....do	....do	450	....
1548	....do	Illinois, northern district	100	14.85
1575	....do	Kansas	275	....
1591	....do	Illinois, northern district	100	14.95
1601	....do	Kansas	275	....
1612	....do	....do	100	178.42
1613	....do	Texas, northern district	100	65.40
1634	....do	Kansas	100	718.56
1654	....do	....do	100	
1664	....do	....do	100	
1671	....do	....do	100	
1672	....do	....do	100	
1673	....do	....do	100	
1684	....do	....do	100	
1685	....do	....do	100	
1686	....do	....do	100	
1688	....do	....do	100	
1691	....do	....do	100	
1692	....do	....do	100	
1711	....do	Missouri, western district	100	19.75
1712	....do	Kansas	450	59.71
1713	....do	....do	450	
1714	....do	....do	100	53.51
1738	....do	....do	100	33.10
1739	....do	....do	100	32.50
1743	....do	....do	100	32.30
1745	....do	....do	100	32.80
1754	....do	....do	100	37.65
1764	....do	....do	100	17.50
1765	....do	....do	100	39.35
677	Baltimore and Ohio Southwestern	Ohio, southern district	100	13.87
761	....do	....do	100	13.75
776	....do	....do	100	13.75
777	....do	....do	100	13.81
970	....do	....do	100	13.87

Statistical summary of suits under the twenty-eight hour law resulting in judgment for the Government during the fiscal year from July 1, 1908, to June 30, 1909—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
971	Baltimore and Ohio Southwest	Ohio, southern district	$100	$13.75
1173	do	do	100	13.87
1427	Chicago, Burlington and Quincy	Illinois, southern district	100	19.58
1446	do	Missouri, western district	100	21.55
1523	do	Illinois, northern district	100	14.60
1524	do	do	100	14.60
1525	do	do	100	14.60
1526	do	do	100	14.60
1527	do	do	100	14.60
1570	do	do	100	14.60
1576	do	Iowa, southern district	100	....
1583	do	Illinois, northern district	100	14.60
1584	do	do	100	14.60
1586	do	do	100	14.70
1597	do	Illinois, southern district	100	19.98
1633	do	Illinois, northern district	100	14.30
404	Cleveland, Cincinnati, Chicago and St. Louis.	Ohio, northern district	100	21.06
792	Chicago, Milwaukee and St. Paul	Illinois, northern district	100	17.70
844	do	do	100	18.06
857	do	do	100	18.00
858	do	do	100	17.91
1034	do	do	100	18.06
1064	do	Minnesota	100	18.56
1463	do	Illinois, northern district	100	17.85
1464	do	do	100	17.36
1479	do	do	100	14.10
1481	do	do	100	14.10
1489	do	do	100	14.10
1504	do	do	100	14.10
1505	do	do	100	14.10
1506	do	do	100	14.10
1508	do	do	100	14.10
1509	do	do	100	14.10
1510	do	do	100	14.10
1511	do	do	100	14.10
1519	do	do	100	14.10
1520	do	do	100	14.10
1530	do	do	100	14.10
1531	do	do	100	14.10
1532	do	do	100	14.10
1533	do	do	100	14.10
1534	do	do	100	14.10
1535	do	do	100	14.10
1536	do	do	100	14.10
1553	do	do	100	14.10
1554	do	do	100	14.10
1588	do	do	100	14.10
1592	do	do	100	14.10
1593	do	do	100	14.10
1606	do	do	100	14.10
1609	do	do	200	28.20
1614	do	do	100	14.10
1615	do	do	100	14.10
1616	do	do	100	14.10
1657	do	do	100	13.75
1689	do	Minnesota	250	20.50
676	Chicago and Northwestern	Nebraska	100	82.47
1403	do	do	150	644.20
1404	do	do	150	
1507	do	Illinois, northern district	100	14.60
1558	do	do	100	14.60
1559	do	do	100	14.60
1560	do	do	100	14.60
1585	do	do	100	14.60
1587	do	do	100	14.60
1602	do	do	100	14.60
1603	do	do	100	14.70
1618	do	do	100	14.30
1619	do	do	100	14.30
1620	do	do	100	14.30
1624	do	do	100	13.85
1625	do	do	100	14.30
1626	do	do	100	13.85
1627	do	do	100	13.85
1628	do	do	100	14.30
1629	do	do	100	14.30
1631	do	do	100	13.85
1637	do	do	100	13.85
1638	do	do	100	13.85

Statistical summary of suits under the twenty-eight hour law resulting in judgment for the Government during the fiscal year from July 1, 1908, to June 30, 1909—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
1639	Chicago and Northwestern	Illinois, northern district	$100	$13.85
1640	do	do	100	13.85
1648	do	do	100	13.85
1649	do	do	100	13.85
1650	do	do	100	13.85
1651	do	do	100	13.85
1652	do	do	100	13.85
1653	do	do	100	13.85
1663	do	South Dakota	100	95.83
1722	Chicago, Rock Island and Gulf	Texas, northern district	100	149.10
1723	do	do	100	
1724	do	do	100	
1725	do	do	100	
1726	do	do	100	
1727	do	do	100	
1728	do	do	100	
1729	do	do	100	
1730	do	do	100	
1731	do	do	100	
1732	do	do	100	
1750	do	do	100	
1751	do	do	100	
1752	do	do	100	
1753	do	do	100	
1762	do	do	100	
228	Chicago, Rock Island and Pacific	Kansas	100	83.30
229	do	do	100	
231	do	do	100	
233	do	do	100	
234	do	do	100	
235	do	do	100	
236	do	do	100	
406	do	do	100	
407	do	do	100	
408	do	do	100	
409	do	do	100	
410	do	do	100	
466	do	do	100	
467	do	do	100	
468	do	do	100	
503	do	do	100	
504	do	do	100	
505	do	do	100	
507	do	do	100	
508	do	do	100	
510	do	do	100	
511	do	do	100	
512	do	do	100	
513	do	do	100	
514	do	do	100	
515	do	do	100	
517	do	do	100	
590	do	do	100	
629	do	do	100	
715	do	do	100	
716	do	do	100	
758	do	do	200	
397	do	do	250	53.00
398	do	do	250	
399	do	do	350	
454	do	do	100	
455	do	do	100	
456	do	do	100	
457	do	do	100	
458	do	do	100	
459	do	do	250	
460	do	do	100	
461	do	do	100	
462	do	do	100	
463	do	do	100	
464	do	do	100	
465	do	do	100	
787	do	do	100	25.10
812	do	do	100	
814	do	do	100	
815	do	do	100	
671	do	do	240	37.45
672	do	do		
834	do	do	120	....

Statistical summary of suits under the twenty-eight hour law resulting in judgment for the Government during the fiscal year from July 1, 1908, to June 30, 1909—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
929	Chicago, Rock Island and Pacific	Kansas	$100	$84.15
938	do	do	100	
965	do	do	100	
966	do	do	100	
982	do	do	100	
983	do	do	100	
984	do	do	100	
1038	do	Oklahoma, western district	200	72.11
1056	do	Kansas	100	39.40
1080	do	do	100	
1083	do	do	100	
1121	do	do	100	
1254	do	do	250	27.45
1317	do	do	200	
1318	do	do	200	
1357	do	do	100	31.30
1386	do	do	100	
1387	do	do	100	
1430	do	do	100	103.03
1447	do	do	100	20.85
1453	do	do	100	
1354	do	Missouri, western district	100	22.14
1474 1475 1476	do	Kansas	300	....
1521	do	Illinois, northern district	100	13.75
1522	do	do	100	13.75
1577	do	do	100	13.75
1578	do	do	100	13.70
1569	do	Kansas	125	....
1608	do	Missouri, western district	100	24.75
1632	do	Illinois, northern district	100	14.30
1635	do	Arkansas, eastern district	100	17.65
1636	do	Illinois, northern district	100	14.30
1659	do	Kansas	100	21.45
1660	do	do	100	
1690	do	Arkansas, eastern district	100	17.70
1740	do	Kansas	100	18.80
1746	do	do	100	18.50
1666	do	do	125	50.61
1667	do	do	125	
1668	do	do	125	
1669	do	do	125	
1749	Chicago and Alton	Missouri, western district	100	20.00
1644	Charleston and Western Carolina	South Carolina	100	177.14
802	Chicago Great Western	Illinois, northern district	100	18.20
1500	do	Iowa, southern district	100	22.56
1513	do	Illinois, northern district	100	14.50
1808	do	Minnesota	150	21.62
1503	Colorado and Southern	Colorado	400	54.84
970	Cincinnati, New Orleans and Texas Pacific.	Ohio, southern district	100	14.22
971	do	do	100	14.10
1697	Denver and Rio Grande	Colorado	100	220.07
1701	do	do	100	
925	Fort Worth Belt	Texas, northern district	250	7.85
237 253 253½	Great Northern	North Dakota	200	35.30
246	do	do	200	35.30
418	do	Montana	500	67.65
833	do	North Dakota	200	35.30
981 1002	do	do	200	30.40
1029	do	do	200	35.30
1465 1466 1467 1468	do	do	600	35.00
1473	do	do	150	35.60
1477	do	Minnesota	300	19.92
1482	do	do	300	
1485	do	do	300	19.47
1487	do	do	300	
1488	do	do	300	
1494	do	do	200	19.47
1495	do	do	200	
1496	do	do	200	
1497	do	do	200	19.72
1498	do	do	200	19.47

Statistical summary of suits under the twenty-eight hour law resulting in judgment for the Government during the fiscal year from July 1, 1908, to June 30, 1909—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
1784	Great Northern	Minnesota	$350	$19.77
1538	do	Washington, eastern district	250	22.36
1589	do	do	150	28.46
1540	Illinois Central	Illinois, northern district	100	14.75
1541	do	do	100	14.60
1542	do	do	100	14.60
1555	do	do	100	14.75
1556	do	do	100	14.60
1557	do	do	100	14.60
1571	do	do	100	14.85
1655	do	do	100	13.85
1710	do	Minnesota	100	13.16
1670	Kansas City, Mexico and Orient	Kansas	100	116.41
1665	Kansas City Southern	do	100	33.76
1623	Lake Shore and Michigan Southern	Illinois, northern district	100	13.75
1642	do	do	100	13.75
1656	do	do	100	13.75
1167	Missouri Pacific	Missouri, western district	100	21.10
1228	do	Illinois, northern district	100	19.25
1239	do	Missouri, eastern district	100	22.26
1240	do	do	100	
1356	do	Kansas	100	26.65
1378	do	do	150	
1444	do	do	100	
1662	do	do	150	18.90
1700	do	do	100	21.15
1701	do	do	100	
1063	Missouri, Kansas and Texas	do	400	185.00
1076	do	do	400	
1081	do	do	400	
1501	do	do	400	65.55
1630	do	Texas, northern district	100	5.20
1645	do	Texas, eastern district	100	40.30
1693	do	Oklahoma, western district	100	146.05
1703	Minneapolis, St. Paul and Sault Ste. Marie.	Minnesota	100	36.47
1385	Minneapolis and St. Louis	do	200	48.77
603	New York Central and Hudson River	Massachusetts	250	53.80
604	do	do	250	
606	do	do	200	
640	do	do	200	
641	do	do	200	
1325 1326 1327 1328 1329 1330 1331 1332	Northern Pacific	North Dakota	600	99.08
1538	do	Washington, western district	150	24.34
1580	do	Washington, eastern district	500	35.96
594	Oregon Railroad and Navigation Co	Oregon	250	30.50
607	do	do	250	28.30
808	do	do	250	13.80
926	do	do	100	241.44
1345	do	do	250	37.82
1345	Oregon Short Line	Idaho	200	41.11
1402	Pennsylvania	Pennsylvania, western district	200	96.80
1389	Pere Marquette	New York, western district	100	17.26
1565	Pittsburg, Cincinnati, Chicago and St. Louis.	Ohio, southern district	100	14.06
721	St. Louis and San Francisco	Texas, northern district	500	
1047	do	Missouri, western district	100	10.85
1079	do	Kansas	100	27.15
1082	do	do	100	
1130	do	do	150	
1151	do	do	100	
1087	do	do	100	23.15
1194	do	do	100	
1696	do	do	100	
1207	do	do	100	28.25
1211	do	do	100	
1333	do	do	100	
1334	do	do	100	
1335	do	do	150	
1351	do	Missouri, western district	100	82.55
1359	do	Kansas	100	20.90
1561	do	do	100	
1371	do	Missouri, western district	100	10.70

Statistical summary of suits under the twenty-eight hour law resulting in judgment for the Government during the fiscal year from July 1, 1908, to June 30, 1909—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
1373	St. Louis and San Francisco	Missouri, western district	$100	$10.70
1377	....do	Kansas	100	18.60
1382	....do	Missouri, western district	100	10.70
1416	....do	....do	200	11.00
1440	....do	....do	200	10.70
1441	....do	....do	200	10.70
1699 1704 1705	....do	Kansas	300	25.65
1709	....do	Missouri, western district	100	30.10
480	....do	Missouri, eastern district	100	540.13
481	....do	....do	100	
478	....do	....do	100	
598	....do	....do	100	
599	....do	....do	100	
600	....do	....do	100	
741	....do	....do	100	
742	....do	....do	100	
743	....do	....do	100	
745	....do	....do	100	
747	....do	....do	100	
750	....do	....do	100	
796	....do	....do	100	
797	....do	....do	100	
798	....do	....do	100	
823	....do	....do	100	
824	....do	....do	100	
840	....do	....do	100	
841	....do	....do	100	
861	....do	....do	100	
862	....do	....do	100	
863	....do	....do	100	
864	....do	....do	100	
865	....do	....do	100	
866	....do	....do	100	
867	....do	....do	100	
868	....do	....do	100	
869	....do	....do	100	
905	....do	....do	100	
906 908	....do	....do	100	
913	....do	....do	100	
922	....do	....do	100	
928	....do	....do	100	
947	....do	....do	100	
949	....do	....do	100	
950	....do	....do	100	
951	....do	....do	100	
953	....do	....do	100	
954	....do	....do	100	
959	....do	....do	100	
1003	....do	....do	100	
1021 1133	....do	....do	100	
1031	....do	....do	100	
1032	....do	....do	100	
1033	....do	....do	100	
1041	....do	....do	100	
1042 1043	....do	....do	100	
1044	....do	....do	100	
1094	....do	....do	200	
1095	....do	....do	100	
1096	....do	....do	100	
1098	....do	....do	200	
1099 1100	....do	....do	200	
1101	....do	....do	100	
1102	....do	....do	200	
1104	....do	....do	200	
1107 1108 1109 1111	....do	....do	100	
1110	....do	....do	100	
1112	....do	....do	100	
1115	....do	....do	100	
1118	....do	....do	100	
1122	....do	....do	100	
1136	....do	....do	100	
1170	....do	....do	100	

Statistical summary of suits under the twenty-eight hour law resulting in judgment for the Government during the fiscal year from July 1, 1908, to June 30, 1909—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
1191	St. Louis and San Francisco	Missouri, eastern district	$100	
1205	do	do	100	
1206	do	do	100	
1246	do	do	100	
1247	do	do	100	
1248	do	do	100	
1249	do	do	300	
1250	do	do	200	
1251	do	do	200	
1304	do	do	100	
1305 1306	do	do	100	
1307 1308	do	do	100	
1309	do	do	100	
1319	do	do	100	
1321	do	do	100	
1322	do	do	100	
1343	do	do	100	
1349	do	do	100	
1411 1412 1413	do	do	100	
1543	do	do	100	
1544	do	do	100	
1545	do	do	100	
1573	do	do	100	
1579	do	do	100	
1419	do	do	100	
1421	do	do	100	
1438	do	do	100	
1439	do	do	100	
1448	do	do	100	
1456	do	do	100	
1457	do	do	100	
1458	do	do	100	
1698	do	do	100	
1706	do	do	100	
1707	do	do	100	
1742	do	do	100	
472	St. Louis, Iron Mountain and Southern	do	100	$33.48
471	do	do	100	
542	do	do	100	
476	do	do	100	
799	do	do	100	
778	do	do	100	
475	do	do	100	40.65
955	do	do	100	
960 962 963	do	do	100	
961 1004	do	do	100	
997 998 999	do	do	100	
1084	do	do	100	
477	do	do	100	20.96
1193	do	do	100	39.70
1199	do	do	100	
1252	do	do	100	
1323	do	do	100	
1324	do	do	100	
1420	do	do	100	35.89
1425	do	do	100	
1661	do	Arkansas, eastern district	200	79.96
1676	do	do	100	
1702	do	do	100	96.28
1716	do	do	250	18.35
1741	do	do	100	16.95
596 800	St. Louis Merchants' Bridge Terminal	Missouri, eastern district	100	37.98
765	do	do	100	
766	do	do	100	
782	do	do	100	
783	do	do	100	
784	do	do	100	
806	do	do	100	
976	do	do	100	25.75
978	do	do	100	

Statistical summary of suits under the twenty-eight hour law resulting in judgment for the Government during the fiscal year from July 1, 1908, to June 30, 1909—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
1152	St. Louis Merchants' Bridge Terminal	Missouri, eastern district	$100	$20.64
1437	do	do	100	20.60
1678	do	do	100	26.10
1679	do	do	100	
1680	do	do	100	
1736	do	Illinois, eastern district	100	16.50
1737	do	do	110	
1769	do	do	100	16.50
1805	do	do	110	
818	Southern	North Carolina, western district	100	93.72
1757	Southern Pacific	Oregon	250	171.52
1767	do	do	350	496.85
471 472	Terminal Railroad Association of St. Louis.	Missouri, eastern district	100	47.82
476	do	do	100	
477	do	do	100	
478	do	do	100	
542	do	do	100	
778	do	do	100	
795	do	do	100	
796	do	do	100	
797	do	do	100	
798	do	do	100	
799	do	do	100	
805	do	do	100	
598	do	do	100	47.78
599	do	do	100	
600	do	do	100	
741	do	do	100	
742	do	do	100	
743	do	do	100	
745	do	do	100	
746	do	do	100	
747	do	do	100	
750	do	do	100	
759	do	do	100	
760	do	do	100	46.78
841	do	do	100	
861	do	do	100	
862	do	do	100	
865	do	do	100	
866	do	do	100	
867	do	do	100	
868	do	do	100	
869	do	do	100	
870	do	do	100	
871	do	do	100	
872	do	do	100	
475	do	do	100	47.38
928	do	do	100	
946	do	do	100	
947	do	do	100	
949	do	do	100	
950	do	do	100	
951	do	do	100	
953	do	do	100	
954	do	do	100	
955	do	do	100	
990	do	do	100	
902 919	do	do	100	43 09
905	do	do	100	
906 908	do	do	100	
1031	do	do	100	
1032	do	do	100	
1033	do	do	100	
1039	do	do	100	
1041	do	do	100	
1205 1206	do	do	100	22.18
1094 1104	do	Illinois, eastern district	100	33.74
1251	do	do	110	
1708	do	do	100	31.49
661	Union Pacific	Nebraska	200	148.93
662	do	do	200	
663	do	do	200	

Statistical summary of suits under the twenty-eight hour law resulting in judgment for the Government during the fiscal year from July 1, 1908, to June 30, 1909—Continued.

Case No.	Railroad involved.	Judicial district.	Penalty assessed.	Costs assessed.
1279	Union Pacific	Nebraska	$100	$1,256.06
1280	do	do	100	
1281	do	do	100	
1282	do	do	100	
1283	do	do	100	
1284	do	do	100	
1552	do	do	250	49.85
1748	do	Utah	300	20.70
1242	Vandalia	Indiana	100	16.32
1117	Wabash	Missouri, eastern district	100	18.94

Six hundred and seventeen cases; penalties recovered, $73,490; costs recovered, $11,539.85.

THE LACEY ACT.

Only one case under the act of May 25, 1900, commonly known as the Lacey Act, was reported to the Attorney-General during the year. This is, however, no indication of a marked decrease in the number of offenses against the act, but rather an accentuation of the difficulty of procuring the necessary evidence to maintain prosecutions. As pointed out in the previous reports of this Office, the act in its present form is difficult of enforcement because of the impossibility in most cases of securing direct evidence of the unlawful killing of the game animals and birds interstate commerce in which is prohibited thereby. Your recommendation of certain amendments to the act to more effectually accomplish the objects plainly contemplated by its context and asserted in the debates when the bill was before Congress, made to the House Committee on Codification of the Penal Laws last year, were substantially adopted and incorporated in section 243 of the penal code which was approved on March 4 last, to become effective on January 1 next. Under the provisions of the new act it will be possible to materially lessen the offenses now committed against the spirit of the original act and necessarily against the game laws of the States. Heretofore serious doubts have prevailed as to the scope of section 4 of the act, it being maintained by some that the only packages which are required by this section to be plainly marked with the nature of the contents and name of shipper are those containing game killed in violation of local laws, while others construe the provision to embrace only packages containing game lawfully killed the export of which is not prohibited by law of the State where killed, and still others hold that it applies to packages containing game, whether killed lawfully or unlawfully, or the export of which is permitted or prohibited by the laws of the State where killed. This difficulty of properly interpreting the language of the act is entirely obviated by the amendment heretofore mentioned, which requires all packages containing the dead bodies or parts thereof of game animals and game or other wild birds, when shipped from one State to another or to a foreign country, to be plainly marked so that the name and address of the shipper and nature of the contents may be readily ascertained by inspection of the outside of the package. Section 3 of the act was also materially amended so as to include within its provisions the prohibition of the shipment from one State to another of wild animals and birds the shipment of which is prohibited by the laws of the State where killed or from which they are shipped.

As before stated, the act as amended will go into force on the 1st day of January next, and steps have already been taken looking to the vigorous enforcement of the act after that date. It is confidently believed that the administration of this act, as amended, will largely increase the work of this Office, and beyond all else will effectually suppress the now too flagrant and frequent violations of the game laws of the States.

Four cases, consolidated for trial, were determined during the year, all against the same person, in the western district of Oklahoma. These cases involved the illegal shipment of more than 500 quail and the trial resulted in the conviction of the defendant and imposition of four $100 fines. The act prohibits the shipment in interstate commerce of game killed in violation of local laws. Judge Cotteral charged the jury in these cases that game killed for the purpose of shipping it out of a State which prohibits such shipment is killed in violation of law and is within the provisions of the act of Congress. This is the first judicial pronouncement on this point and is of material importance in the enforcement of the act.

The following table is intended to show the cases under the act reported to the Attorney-General during the year, those pending at the expiration of the last fiscal year, and the disposition and present status of these cases:

Cases under the Lacey Act (act of May 25, 1900) coming over from previous year and reported to the Attorney-General during the fiscal year 1909.

Case No.	Defendant.	Judicial district.	Offense charged.	Disposition or present status of case.
20	Paris N. Rupert	Oklahoma, western district.	Interstate shipment of quail killed in violation of laws of Oklahoma.	Convicted; fined $100.
20a	do	do	do	Do.
20b	do	do	Interstate shipment of quail in box not properly marked.	Do
20c	do	do	do	Do.
94	Northern Produce Co.	Texas, southern district.	Interstate shipment of wild ducks in packages not properly marked.	Pending.
124	Guy Miller Produce Co.	Oklahoma, western district.	Interstate shipment of quail killed in violation of laws of Oklahoma and shipped in boxes not properly marked.	Do.
125	Rabito - Battistella Fish and Oyster Co.	Louisiana, eastern district.	Interstate shipment of wild ducks in packages not properly marked.	Do.
M-101	J. D. Carson	Iowa, northern district.	Interstate shipment of prairie chickens killed in violation of the laws of Iowa.	Reported to Attorney - General June 22, 1909.

TRESPASS ON BIRD RESERVES.

The act of June 28, 1906 (34 Stat., 536, now section 84, penal code of March 4, 1909), prohibiting hunting, trapping, capturing, willfully disturbing or killing any bird or the taking of its eggs on any lands of the United States set apart or reserved by law, proclamation, or executive order for use of the Department of Agriculture as breeding grounds for native birds, has accomplished a large measure of the purpose for which it was intended. At the time of its enactment the number of reserves did not exceed 10, but at the date of this report there are 51, located in widely separated sections of the United States, the larger number of which were created during the last year and a half of President Roosevelt's administration. With this very large increase in territory over which the act operates it reasonably is to be assumed that occasional offenses will occur. The temptation to hunt on the reserves of the Department, where, through vigilant protection, the birds have become numerous and comparatively unwary, is very great, and enough to encourage certain classes of hunters, for the present, at least, to hope that they may successfully evade the law.

Only one infraction of the act came to the attention of the Department during the year. The facts were promptly reported to the Attorney-General, prosecution was immediately instituted, and was pending at the close of the fiscal year.

CONVERSION OF PROPERTY OF THE DEPARTMENT.

During the year three cases of conversion of property of the Weather Bureau were submitted to this Office for action after unsuccessful efforts of the Bureau officers to effect its return. These cases involved the unlawful retention by former employees of the Bureau of valuable instruments intrusted to them in connection with their official duties. The facts were promptly reported to the Attorney-General and instructions were given the United States attorneys to take the necessary steps to secure the property. In one of the cases the property was returned without suit; in another an action of replevin was pending at the close of the year; and in the third, reported on June 19, no action had been taken before the end of the year. In the two cases, similar to the above, pending at the close of the last fiscal year, the property was returned without the necessity of action in the courts.

CASES IN THE COURT OF CLAIMS.

At the close of the last fiscal year there were pending in the Court of Claims two cases based upon transactions arising in the Department. One of them, Crary, Packer and Knott *v.* United States, a suit for recovery of $8,693, the alleged value of 5,238 sheep imported from Mexico and slaughtered by an inspector of the Department because of their exposure to, and infection with, scabies, was finally determined on February 15 of the present year by rendition of judgment in favor of the claimants for $3,979, the value of that portion of the sheep not actually diseased and the amount of the duty thereon. The other case, Thos. H. Reeves *v.* United States, based on a claim for salary disallowed by the Department, was still pending at the close of the year. In both of these cases this Office, at the request of the Assistant Attorney-General handling the case, furnished a large amount of material, including facts, requests for findings, and authorities to support the contentions of the Government.

FALSIFICATION OF ACCOUNTS.

In October, 1908, John B. Marbury, formerly in charge of the Weather Bureau station at Atlanta, Ga., pleaded guilty to an indictment in the district court of the United States for the northern district of Georgia, based upon sections 3490 and 5438 of the Revised Statutes, charging him with the crime of knowingly making false claims in his accounts with the Department. He was sentenced to pay a fine of $250. This is the only case of this character brought to the attention of the Department during the year, despite careful scrutiny by the accounting officers of the hundreds of accounts submitted for settlement during that time.

SUPPRESSION OF CONTAGIOUS DISEASES OF DOMESTIC ANIMALS.

Nine cases involving violations of the act of May 29, 1884, "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," were reported to the Attorney-General during the year, an increase of one over the previous year. In addition to these, there were four which remained unsettled at the expiration of the last year. One of these cases resulted in the imposition of a fine of $100; eight were pending at the close of the year; two were dismissed; the grand jury refused to indict in another; and in the last the defendant was discharged on preliminary hearing.

The following table shows the nature of the offenses charged and the disposition or present status of these cases:

Cases under act of May 29, 1884, for suppression of contagious diseases of animals, unsettled at close of fiscal year 1908 and reported during fiscal year 1909.

Case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or present status of case.
Q 36	H. J. Benson	Iowa, northern district.	Shipment of sheep infected with scabies.	Defendant indicted; pending.
Q 39	Richards & Roberts.	Wisconsin, western district.	Shipment of 9 separate consignments of 1,220 sheep infected with scabies.	Pending.
Q 42	B. Waldron	Indiana	Shipment of sheep infected with scabies.	Do.
Q 43	H. J. Benson	Iowa, northern district.	do	Defendant indicted; pending.
Q 49	William Haley	Michigan, eastern district.	do	Dismissed.
Q 53	C. F. Le Valley	Iowa, southern district	do	Pending.
Q 55	H. H. Brownell	Nebraska	Shipment of cattle infected with scabies.	Do.
Q 60	H. S. Baumgaardner.	Iowa, northern district.	Shipment of sheep infected with scabies.	Dismissed.
Q 68	W. H. Whaley, jr.	Kentucky, eastern district.	do	Pending.
Q 69	A. J. Franklin	Minnesota	do	Defendant discharged on preliminary hearing.
Q 71	J. S. Trauter	Iowa, southern district	do	Pending.
Q 72	Barney Thier	Minnesota	do	Defendant pleaded guilty; fined $100.
Q 74	J. B. Wampler	Missouri, western district.	do	Grand jury refused to indict.

QUARANTINE LAW AND REGULATIONS.

PROSECUTIONS OTHER THAN FOR VIOLATIONS OF REGULATIONS REQUIRING CARRIERS TO PLACARD CARS AND STAMP SHIPPING MEMORANDA.

Thirty-three cases involving violations by individuals and carriers of the act of March 3, 1905, "An act to enable the Secretary of Agriculture to establish and maintain quarantine districts, to permit and regulate the movement of cattle and other live stock therefrom, and for other purposes," were reported to the Attorney-General during the year, an increase of 27 over the previous year. These cases do not include those against carriers for violation of the regulations requiring cars, in which, and shipping memoranda on which, cattle are transported from States or Territories quarantined for Texas or splenetic fever to be placarded and stamped "Southern cattle," "Uninspected exposed cattle," "Uninspected clean cattle," "Dipped scabby cattle," or "Cattle exposed to scabies," as the case may be.

In addition to the cases reported during the year there were five which remained unsettled at the expiration of the last year. Four of the cases resulted in conviction or pleas of guilty and imposition of fines of $300 in one, $100 in two, and $100 with a commitment to jail for thirty days in another. Defendant was acquitted in one case; the grand juries refused to indict in three cases; one was withdrawn, and the remaining twenty-nine cases were pending at the close of the year. There were also two cases instituted in South Carolina by the United States attorney for that district, sua sponte, both against individuals, for driving cattle from quarantined area in Georgia into South Carolina in violation of the regulations of the Secretary of Agriculture. One of the defendants pleaded nolo contendere and was fined $100. The other pleaded guilty and was committed to jail for thirty days. Six of the foregoing cases grew out of shipments or movement of cattle from the States quarantined during the early part of the year for foot-and-mouth disease and it was in one of these that the $300 fine was imposed. It will be seen from the foregoing that in three cases the grand juries refused to indict, but in much the larger number of cases reported for prosecution the United States attorneys have been successful in securing indictments. On the whole the law is working admirably and has already accomplished beneficial results far in excess of the most sanguine expectations. When the vast extent of territory over which the law is operative is compared with the trifling number of violations reported during the year, it must be apparent that the law is substantially observed and respected.

The following table is a recapitulation of the foregoing cases, with added details.

Cases under act of March 3, 1905, for movement or shipment of domestic animals from quarantined State or Territory without permit, inspection, treatment, or certificate, or to a place other than a recognized slaughtering center, reported, finally determined, or pending during or at the close of the fiscal year 1909.

Case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or status of the case.
Q 35	Walter Johnson	Tennessee, eastern district.	Driving cattle from quarantined area to another State.	Defendant acquitted.
Q 41	J. F. Ravenscroft and John A. Edwards.	Oklahoma, western district.	Driving uninspected sheep from quarantined area to another State.	Pending.
Q 45	James Marler and J. H. Ballantyne.	Idaho	do	Do.
Q 46	John Zane and Elmer Edwards.	Oklahoma, eastern district.	Driving diseased cow from quarantined territory into another State.	Do.
Q 47	L. D. Hoy	Oregon	Driving sheep from quarantined State to another State.	Do.
Q 48	E. A. Maxwell and S. C. Davis.	Arkansas, eastern district.	Driving cattle from quarantined area to another State.	Defendant indicted; pending.
Q 50	R. L. McCary and A. J. James.	Texas, northern district.	Driving uninspected sheep from quarantined State to another State.	Defendants arrested; held for grand jury.
Q 51	Jacob Benoin	New York, southern district.	Driving uninspected cattle from quarantined State to another State.	Defendant pleaded guilty; fined $300.
Q 52	Texas and Pacific Railway Co.	Texas, northern district.	Transportation of sheep from quarantined State to another State without certificate of inspection.	Pending.
Q 52a	St. Louis, Iron Mountain and Southern Railway Co.	Missouri, eastern district.	do	Defendant pleaded guilty; fined $100.
Q 52b	Terminal R. R. Association of St. Louis.	do	do	Pending.
Q 54	J. W. Sellers	Missouri, western district.	Driving cattle from quarantined area to another State.	Defendant pleaded guilty; committed to jail for 30 days and fined $100.
534a	Louisville and Nashville Railroad Co.	Tennessee, middle district.	Transportation of stock from quarantined State to other than recognized slaughtering center.	Withdrawn.
535a	Atchison, Topeka and Santa Fe Railway Co.	Kansas	Transportation of stock from quarantined State without certificate of inspection.	Information filed; pending.
536a	Texas and Pacific Railway Co.	Texas, northern district.	do	Pending.
537a	St. Louis and San Francisco Railroad Co.	Arkansas, eastern district.	Transportation of stock from quarantined State to other than recognized slaughtering center.	Defendant convicted; fined $100.
579a	Louisville and Nashville Railroad Co.	Illinois, eastern district.	do	Information filed; demurrer thereto pending.
Q 56	Fred Craig	Indiana	Driving stock from quarantined State to another State.	Pending.
Q 57	Taylor Stevenson	Louisiana, western district.	do	Do.
Q 58	Chicago, Burlington and Quincy Railway Co.	Montana	Transportation of uninspected sheep from quarantined State to another State.	Grand jury refused to indict.
Q 59	T. K. Obray	Utah	Driving uninspected sheep from quarantined State to another State.	Pending.
Q 61	J. B. Hampton	South Carolina	Shipment of cow from quarantined State to another State.	Complaint filed; defendant arrested; pending.
Q 62	Rossell Sammons	Pennsylvania, western district.	Driving sheep from quarantined State to another State.	Pending.
Q 63	Erie Railroad Co.	New York, western district.	Transportation of cattle from quarantined State to another State.	Defendant indicted; pending.
Q 64	Chas. McElwain	do	Shipment of cattle from quarantined State to another State.	Do.
Q 65	do	do	Shipment of stock from quarantined State to another State.	Do.
Q 66	Willard Letcher	Michigan, eastern district.	Driving stock from quarantined State to another State.	Grand jury refused to indict.

Cases under act of March 3, 1905, for movement or shipment of domestic animals from quarantined State or Territory without permit, inspection, treatment, or certificate, or to a place other than a recognized slaughtering center, reported, finally determined, or pending during or at the close of the fiscal year 1909—Continued.

Case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition or status of the case.
Q 67	St. Louis and San Francisco R. R. Co. and L. A. Jinkins.	Oklahoma, western district.	Shipment and transportation of cattle from quarantined State to another State.	Pending.
Q 73	Hugh Shadows	Tennessee, middle district.	Driving cattle from quarantined State to another State.	Grand jury failed to indict.
Q 77	M. V. Robertson	Texas, northern district.	Driving uninspected cattle from quarantined State to another State.	Pending.
Q 78	J. A. Carter	Arkansas, eastern district.	do	Do.
Q 79	J. A. Beggs	Missouri, eastern district.	Shipment of cattle from quarantined State to another State.	Do.
Q 80	G. T. Storey	Missouri, western district.	Driving uninspected cattle from quarantined State to another State.	Do.
Q 82	E. P. Johnson and W. W. Luna.	do	do	Do.
Q 85	Gulf, Colorado and Santa Fe Ry. Co.	Texas, eastern district.	Transportation of stock from quarantined State for other than immediate slaughter.	Do.
Q 86	do	do	do	Do.
Q 98	J. Barudoni	California, northern district.	Driving uninspected sheep from quarantined State to another State.	Do.
Q 99	W. S. and W. A. Hall.	Missouri, western district.	do	Do.
Q 99a	T. B. Evans	South Carolina	Driving cattle from quarantined State to another State.	Defendant pleaded guilty; committed to jail 30 days.
Q 99b	I. N. Holland	do	do	Defendant pleaded nolo contendere; fined $100.

PROSECUTIONS AGAINST RAILROADS FOR VIOLATION OF THE REGULATIONS REQUIRING CARRIERS TO PROPERLY PLACARD CARS AND STAMP SHIPPING MEMORANDA.

At the close of the fiscal year 1908 there had been reported to the Attorney-General for action 33 cases based upon violations of Regulation 14d requiring carriers to placard cars in which, and stamp memoranda on which, cattle were shipped from States and Territories quarantined for splenetic fever, with the words "Southern cattle." During the present year 127 cases for violations of the amendment to the above regulation, now Regulation 14e, and of Regulations 21, 24, and 32, requiring cars and shipping memoranda in and under which cattle and sheep are conveyed from quarantined States and Territories to be properly placarded and marked, were reported to the Attorney-General. Of the 8 cases coming over from the previous year and of those reported during the present year 27 were closed by pleas of guilty and imposition of fines aggregating $2,800, exclusive of costs, which in several cases amounted to substantial sums, the accurate figures of which were not available for inclusion in the appended table of the cases. There were probably several other cases closed during the year, but the lack of accurate information in respect to them forbids their inclusion in this report. As stated above, pleas of guilty were entered in all the cases which were settled during the year. From this it would appear that enforcement of the act meets with no resistance on the part of the railroads. Such, however, is by no means the case, as is well illustrated in three cases, 513a, 531a, and 532a in the appended table, in the western district of

Kentucky, wherein the Louisville and Nashville Railroad Company interposed demurrers to the indictments on the grounds of insufficiency of the allegations thereof and unconstitutionality of the act. The demurrers were argued with much earnestness on both sides, and the decision thereon taken under advisement by the court. The opinion of the court was rendered on December 4, 1908, and sustained the demurrers as to insufficiency of the allegations of the indictments, but overruled them as to the unconstitutionality of the act, thus sustaining the act as a valid exercise by Congress of the right to enact the statute. The defendant contended that the act was unconstitutional as an attempted delegation to the Secretary of Agriculture of legislative powers, in that it invests the Secretary with authority to make and promulgate rules and regulations which shall permit and govern the inspection, disinfection, certification, treatment, handling, and method and manner of delivery and shipment of cattle and other live stock from quarantined States and Territories. The argument for the Government, so far as the constitutional question was concerned, was presented largely on a brief prepared by this Office at the request of the United States attorney. The defects in the indictments upon which the demurrers were sustained were remedied in new indictments presented by another grand jury shortly after the above decision, and the defendant pleaded guilty and was fined $300 in two of the cases and $100 in the third. In several cases pending at the close of the year similar demurrers had been interposed, decisions upon which had not been made in time for this report. No cases were lost during the year. The inspectors of the Bureau of Animal Industry who procure the evidence in the cases are painstaking and thorough, and when the cases reach the United States attorneys there is very little opportunity for the defendants to escape the penalties prescribed by the act.

The following table shows some of the details of the cases closed during the fiscal year:

Cases under act of March 3, 1905, and regulation 14e, against railroads for transportation of cattle from quarantined States and Territories in cars and under shipping memoranda not placarded and marked "southern cattle," finally determined during the fiscal year 1909.

Case No.	Defendant.	Judicial district.	Disposition of the case.
503a	Wabash Railroad Co	Illinois, eastern district	Defendant pleaded guilty; fined $100.
513a	Louisville and Nashville Railroad Co.	Kentucky, western district	Do.
531a 532a	do	do	Defendant pleaded guilty; fined $300.
538a	Mobile and Ohio Railroad Co	Illinois, eastern district	Defendant pleaded guilty; fined $100.
539a	St. Louis, Iron Mountain and Southern Railway Co.	Arkansas, eastern district	Do.
540a	do	Missouri, eastern district	Do.
541a	Missouri, Kansas and Texas Railway Co.	do	Do.
542a	do	do	Do.
543a	do	do	Do.
550a	Louisville and Nashville Railroad Co.	Kentucky, western district	Do.
551a	St. Louis, Iron Mountain and Southern Railway Co.	Arkansas, eastern district	Do
552a	do	do	Do.
554a	do	Illinois, eastern district	Do.
555a	do	do	Do.
556a	Mobile and Ohio Railroad Co	do	Do.
557a	do	do	Do.
558a	do	do	Do.

Cases under act of March 3, 1905, and regulation 14e, against railroads for transportation of cattle from quarantined States and Territories in cars and under shipping memoranda not placarded and marked "southern cattle," finally determined during the fiscal year 1909—Continued.

Case No.	Defendant.	Judicial district.	Disposition of the case.
559a	Mobile and Ohio Railroad Co	Illinois, eastern district	Defendant pleaded guilty; fined $100.
560a	do	do	Do.
561a	do	do	Do.
577a	do	do	Do.
580a	Illinois Central Railroad Co	do	Do.
582a	Mobile and Ohio Railroad Co	do	Do.
587a	St. Louis and San Francisco Railroad Co.	do	Do.
599a	Illinois Central Railroad Co	do	Do.
600a	Mobile and Ohio Railroad Co	do	Do.

INTERFERENCE WITH EMPLOYEES OF THE BUREAU OF ANIMAL INDUSTRY IN THE PERFORMANCE OF THEIR DUTIES.

During the previous fiscal year there were six instances of serious obstruction by persons in several States to the performance of the Department's duties in connection with the cattle quarantine work and inspection of meats which were the subjects of interstate commerce. Details of these cases were given in the report of this Office for that year. The facts in the cases were reported to the Attorney-General, and all but two of the cases were closed during that year. In one of these latter, involving an assault upon an inspector of the Bureau of Animal Industry while in the discharge of his duties under the meat-inspection law at an establishment in Kansas, the jury acquitted the defendant on a doubt raised by some evidence of mitigating circumstances. The other case of interference by a United States commissioner with the cooperative work of the Bureau of Animal Industry in its effort to assist State authorities in the eradication of cattle fever ticks in Tennessee, resulted in the resignation of the commissioner after petition for his removal had been filed by the United States attorney and before hearing of the case by the court.

Only one instance of interference with the work of the Department occurred during the year, and this was the action of a United States deputy marshal in Tennessee in lending some encouragement by his utterances to a portion of the population of Lincoln County in that State who were disposed to hamper the work of the Department in its effort to cooperate with local authorities in extirpating the cattle fever tick from that county. The facts were reported to the Attorney-General and by him to the marshal for the district, with the result that the deputy protested his innocence of any intention to obstruct the work and earnestly assured the marshal of his purpose to cooperate with the Bureau agents in the future.

PERSONATING AN EMPLOYEE OF THE DEPARTMENT.

During the year information reached the Department that two men, one in Florida and the other in Georgia, were operating in these States under the guise of employees of the Department of Agriculture, using the fraud to further sales of their wares. This Office immediately took the matters up with the United States attorneys in those States in an endeavor to apprehend the offenders for prosecution under the act of April 18, 1884 (23 Stat., 11), which makes this offense a felony punishable by imprisonment for a term not exceeding three years or by fine not exceeding $1,000. Diligent effort was made to locate the parties; instructions were issued by the Postmaster-General to all the post-offices in the districts where the men were operating to keep a lookout for them and report their location if discovered, but it seems they had suspected action on the part of the Government and made their escape. As no further complaints reached the Department after the matters were taken up with the United States attorneys, it seems that the prompt and vigorous action taken had the desired effect.

MEAT INSPECTION.

The meat-inspection amendment of June 30, 1906, although directly affecting the business of a substantial portion of the people of the United States, is rarely infracted, as evidenced by the comparatively small number of cases reported to the Attorney-General during the year for action. Only 44 cases were so reported, an increase of 20, it is true, over the previous year, probably due, however, more to better equipment for detecting violations than to an actual increase in offenses. It is interesting to note that these offenses are almost invariably committed by individuals and rarely by proprietors of establishments of reputation and large business interests. The law is a great success and has steadily grown in favor since its enactment. Of the 44 cases reported during the year, 15 resulted in convictions; 7 were dismissed for lack of evidence of shipment or escape of the offenders; and the rest were still pending in the courts at the end of the year. There were 6 cases closed during the preceding year by imposition of fines, a record of which was not available for inclusion in the report of that year.

The appended table contains the material details of 21 cases resulting in conviction during the last days of the fiscal year 1908, no report of which has been heretofore made, and during the fiscal year 1909.

Cases under meat-inspection amendment of June 30, 1906, closed during the fiscal year 1908, and not reported in the annual report for that year, and during the fiscal year 1909.

M. I. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition of case.
6	George A. Dodge	Pennsylvania, middle district.	Shipment of unwholesome meat of immature calves.	Convicted; fined $10.
7	H. Kleiman	New York, southern district.	Shipment of 2 uninspected carcasses of calves.	Convicted; sentence suspended.
8	John Utter	Pennsylvania, middle district.	Shipment of unwholesome meat of immature calves.	Convicted; fined $10.
9	E. B. Wheaton	do	do	Do.
11	Frank Scott	New York, northern district.	do	Convicted; fined $150.
12	W. J. Drake	do	do	Convicted; sentence suspended.
27	Edward Hinton	Missouri, eastern district.	Destroying labels and marks on tubs of lard and shipping the lard.	Defendant pleaded guilty; fined $100.
28	Hammond, Standish & Co.	Michigan, eastern district.	Shipment of uninspected meat.	Defendant pleaded guilty; fined $30.

Cases under meat-inspection amendment of June 30, 1906, closed during the fiscal year 1908, and not reported in the annual report for that year, and during the fiscal year 1909—Continued.

M. I. case No.	Defendant.	Judicial district.	Nature of offense charged.	Disposition of case.
30	Swift & Co	Ohio, southern district.	Shipment of uninspected meat.	Defendant pleaded guilty; fined $25.
33	Haas & Krohn	Wisconsin, western district.	Shipment of unwholesome meat of immature calves.	Convicted; fined $100.
35	William Rasch	Wisconsin, eastern district.	do	Defendant pleaded guilty; fined $25.
39	Julius Biron	Pennsylvania, eastern district.	Shipment of uninspected meat.	Defendant convicted; fined $25.
39a	Louis Gurst	do	do	Defendant convicted; fined $10.
42	Ojzerkis, Altman & Horowitz.	New York, southern district.	Shipment of uninspected sausage.	Defendant Horowitz pleaded guilty; fined $75.
44	Quong Yee Woo & Co.	do	Shipment of uninspected meat.	Defendants pleaded guilty; fined $100.
47	E. Lichtenstein	Illinois, northern district.	do	Do.
50	J. Jentzol	New York, southern district.	do	Defendant pleaded guilty; fined $5.
51	Edson & Chadwick	New Hampshire	do	Defendant pleaded nolo contendere; fined $100 and costs, $50.
61	Herbert Levy	Louisiana, eastern district.	Falsely using certificate provided for by the meat-inspection amendment.	Defendant pleaded guilty; fined $5.
66	Albert Lips	do	do	Do.
66a	N. Frey	do	Failing to destroy and cancel meat-inspection label.	Do.

GENERAL CORRESPONDENCE WITH THE DEPARTMENT OF JUSTICE.

Correspondence between the Attorney-General and the Secretary during the year was very large, and occupied a substantial portion of the attention of the Solicitor, who is charged not only with the superintendence of this correspondence, but also, in most instances, with the preparation of the Secretary's letters. During the year several opinions of the Attorney-General were requested in connection with the administration of the laws committed to the Department for execution. All these requests were accompanied by brief but full and comprehensive memoranda, prepared in this Office, for the convenience of the Attorney-General in the consideration of the questions, in accordance with his letter of October 15, 1906, asking that this be done.

ORDERS AND REGULATIONS.

All orders and regulations of the Secretary promulgated under statutory authority and affecting the public are examined in advance of issue by the Solicitor, and in many cases are wholly or partly prepared by him. This division of the work of the Office is one of the most important and exacting of all the duties assigned the Solicitor. An examination of the statutes, the administration of which is committed to the Secretary of Agriculture, will disclose how far-reaching, diverse, and intricate are the powers of the Secretary in the promulgation of regulations to effectuate these statutes, and how much care must be exercised in properly drafting the regulations to meet the tests applied to them by the courts.

MEAT-INSPECTION LAW.

Several amendments to the regulations under the meat-inspection law were prepared during the year.

PURE-FOOD LAW.

The purpose and scope of the series of publications designated as ''Food Inspection Decisions'' were fully stated in the last report. Twelve of these decisions were published during the year, in the preparation of which the Solicitor took part.

CATTLE-QUARANTINE LAW.

Several important amendments to the regulations of the Secretary governing inspection, disinfection, certification, treatment, handling, and method and manner of delivery and shipment of live stock which is the subject of interstate commerce were made during the year. The sudden outbreak of foot-and-mouth disease in New York, Pennsylvania, Maryland, and Michigan during the first half of the year led to the quarantine of large portions of these States, requiring the promulgation of several orders and regulations, which were either wholly or partly prepared by this Office.

ALASKA GAME LAW.

Regulations for the administration by the Secretary of certain features of the Alaska game law were prepared and promulgated during the year.

LEGAL PAPERS.

The number of contracts and leases prepared during the present year fell slightly short of the number for the previous year, though the character of many of those prepared during the year was of such a nature as to require unusual skill and care in their preparation.

This Office prepares all the contracts and leases of the Department and exercises supervision over them until final execution. A careful record is preserved in the Office of all these instruments, and in those cases where the renewal at the option of the Secretary is provided for notice is given by this Office to the proper Bureau or Office sufficiently in advance of expiration to preserve the right of the Department to renew. Many of the contracts of the Department are accompanied by bonds to secure their performance, thus necessitating the preparation of another instrument and practically doubling the work in each case. No account is taken of the bonds in the following summary.

GENERAL CONTRACTS.

Supplies.—The supplies for the equipment and conduct of the business of the Department are procured upon competitive bidding and upon award to the successful bidder under contracts, performance of which is usually guaranteed by a bond.

There were 101 of these contracts prepared and perfected during the year, less by 23 than the number prepared during the previous year.

TELEPHONE SERVICE.—The annual contract with the Chesapeake and Potomac Telephone Company for the Department's telephone service was rewritten early in the year.

CONSTRUCTION CONTRACTS.—Four contracts for construction of buildings and improvement of the grounds were prepared by the Department during the year.

CONTRACTS FOR THE SEVERAL BUREAUS AND OFFICES.

BUREAU OF PLANT INDUSTRY.—There were 80 contracts, 30 renewals of contracts, 31 leases, and 21 renewals of leases prepared and perfected for this Bureau during the year, a decrease of 27 contracts, 18 renewals of contracts, and 21 leases, and an increase of 3 renewals of leases in the number so prepared during the previous year.

BUREAU OF ANIMAL INDUSTRY.—There were 22 contracts, 5 renewals of contracts, 37 leases, and 21 renewals of leases prepared and perfected for this Bureau during the year, an increase of 2 contracts and a decrease of 2 renewals of contracts, 2 leases, and 10 renewals of leases in the number so prepared during the previous year.

WEATHER BUREAU.—There were 20 contracts and 1 lease prepared and perfected for this Bureau during the year, an increase of 15 contracts and a decrease of 19 leases in the number so prepared and perfected during the previous year. There were also 85 contracts, 31 leases, and 86 renewals of leases examined for correction and approval during the year, an increase of 70 contracts and 11 leases and a decrease of 8 renewals of leases in the number examined the previous year.

FOREST SERVICE.—There were 2 leases and 2 renewals of leases prepared and perfected for the Forest Service during the year, a decrease of 19 leases and 4 renewals of leases in the number so prepared during the previous year.

BUREAU OF CHEMISTRY.—There were 37 contracts, 32 leases, and 15 renewals of leases prepared and perfected for this Bureau during the year, an increase of 16 contracts and 8 leases and a decrease of 2 renewals of leases in the number so prepared during the previous year.

OFFICE OF EXPERIMENT STATIONS.—There were 3 contracts, 1 renewal of contract, 10 leases, and 5 renewals of leases prepared and perfected for this Office during the year, a decrease of 2 contracts, 2 renewals of contracts, 5 leases, and 2 renewals of leases in the number so prepared during the previous year.

BUREAU OF ENTOMOLOGY.—There were 7 contracts and 10 leases prepared and perfected for this Bureau during the year, a decrease of 2 contracts and 20 leases in the number so prepared during the previous year.

OFFICE OF PUBLIC ROADS.—As in the previous year, only 1 lease was prepared for this Office during the year.

DIVISION OF PUBLICATIONS.—One contract was renewed and 1 lease prepared for this Division during the year, as in the previous year.

RECAPITULATION OF CONTRACTS AND LEASES.

The following table is a recapitulation of the foregoing contracts and leases prepared by this Office during the year, with a restatement, for purpose of comparison, of these instruments prepared during the fiscal year 1908:

Recapitulation and comparative table of contracts and leases prepared during the fiscal years 1908 and 1909.

Department, Bureau, Division, or Office.	1909.		1908.	
	Contracts.	Leases.	Contracts.	Leases.
Department	105	....	128	....
Bureau of Plant Industry	110	52	155	70
Bureau of Animal Industry	27	58	27	70
Weather Bureau	20	1	5	....
Weather Bureau (examined)	85	117	15	114
Forest Service	....	4	....	27
Bureau of Chemistry	37	47	21	41
Office of Experiment Stations	4	15	8	8
Bureau of Entomology	7	10	11	43
Division of Publications	1	1	1	2
Office of Public Roads	....	1	1	1
Total	396	306	372	376

Total contracts and leases in 1908	748
Total contracts and leases in 1909	702
Decrease in 1909	46

BONDS.

Under the act of March 2, 1895 (28 Stats., 807), requiring the reexamination every two years of all bonds of officers and employees of the Department, in order to ascertain the sufficiency of the sureties thereon, a number of such bonds were so examined during the year.

Several requests, under the act of February 24, 1905 (33 Stats., 812), for certified copies of contracts with the Department for buildings and construction work were prepared, and necessary correspondence connected therewith conducted, during the year, for the accommodation of subcontractors desiring to bring suit under that act against the respective contractor.

Many of the officers and employees of the Department are required to furnish bond for the faithful performance of their duties and disbursement of and accounting for funds intrusted to them. There were 58 of these bonds prepared during the year, a decrease of 12 in the number so prepared during the previous year.

ASSISTANCE IN LEGAL PROCEEDINGS.

One of the chief features of the work of this Office during the year was the assistance rendered the United States attorneys handling the cases reported by the Department to the Attorney-General for action. This assistance consisted in suggestions, advice, and the furnishing of extensive legal briefs upon questions arising in the cases pending in the courts. In several instances representatives of this Office have attended the trials in the courts and assisted the United States attorneys in the prosecution of some of the cases. Scarcely a day passed that some such assistance was not rendered, and it is with much satisfaction that it may be said the cooperation between the United States attorneys and this Office has been free, cordial, and productive of splendid results. The repeated requests of the Department for information relative to the progress of its cases through the courts have been uniformly and courteously complied with and in many of its cases the Department has been kept in close touch with the action of the parties and the courts on the initiative of the United States attorneys. As must have already appeared, from what has preceded, the Department's cases have been handled by the United States attorneys with skill and energy, and this occasion should be taken to extend to them all the appreciation of the Department. Since the passage of the food and drugs act of June 30, 1906, the work of the United States attorneys has vastly increased, but notwithstanding this, prompt attention to the cases under this act is the rule with rare exceptions. A more particular description of some of the assistance rendered in legal proceedings during the year will be found elsewhere in this report under specific headings.

PATENTS FOR DEPARTMENT EMPLOYEES.

The work of this Office in prosecuting applications for patents for employees of the Department has been fully explained in the previous annual reports. Seven such applications were filed during the present year; the same number filed during the previous year. Two patents were allowed and two disallowed during the previous year, and four were allowed and two disallowed during the present year. Five applications were pending at the close of the year. Of the four applications pending at the close of the previous year two were allowed and two disallowed. The following table shows the details of the patent cases, action on which was taken during the fiscal year:

Details of applications for patents by employees of the Department prosecuted by the Solicitor during the fiscal year 1909.

Applicant.	Bureau or Office.	Invention.	Disposition or status of application.
John M. Nelson, jr	Forest Service	Improvement in process for treatment of timber with liquid preservatives.	Patent granted Apr. 28, 1909 (No. 441513).
A. G. McAdie	Weather Bureau	Method of assisting forecasters in preparation of weather maps, charts, bulletins, etc.	Patent granted Feb. 9, 1909 (No. 414621).
J. W. T. Duval	Plant Industry	Improvement in laboratory balances.	Disallowed.
A. F. Martins	Animal Industry	Device for stamping meats	Do.
Lore A. Rogers	do	Device for spraying paraffin on butter tubs.	Patent granted Feb. 10, 1909 (No. 460783).
Q. Q. Bradford	Experiment Stations	Knife for tapping rubber trees	Pending.
Milo M. Hastings	Animal Industry	Apparatus for measuring humidity in or for determining evaporating power of air.	Patent granted Jan. 9, 1909 (No. 454280).
F. G. Plummer	Forest Service	Improvement in hypsometers	Pending.
Geo. F. Mitchell	Plant Industry	Shrub and plant trimming machine.	Do.
C. S. Smith	Forest Service	Improvement in wood impregnation.	Do.
D. M. Rogers	Entomology	Insect-destroying bomb	Do.

COMMITTEE ON PERSONNEL.

During the last fiscal year six cases were referred to the committee on personnel for investigation, report, and recommendation. During the present year there were five such cases. The Solicitor, as a member of this committee, was present and participated in the investigation, report, and recommendation in four of these cases. The testimony in one of the cases was very voluminous, involving several employees of the Department and ultimately resulting in a recommendation of dismissal of two and transfer of two others to positions of less importance and responsibility. The committee avoids, whenever possible, any ex parte proceedings and invariably affords the party against whom charges are made full, free, and ample opportunity to produce evidence, and submits its findings and recommendations to the Secretary only after every means has been exhausted to secure all the facts in the case, whether for or against the accused.

PUBLICATIONS.

The circulars of this Office, containing advance information relative to the decisions of the courts in cases involving the laws committed to the Department for administration and enforcement, have been of value to the United States attorneys and the courts, and in several instances have enabled the trial judges to review decisions on the same question before them for determination which had shortly before been passed upon in another district. Without these circulars the Government would undoubtedly have lost some of its cases in the trial courts.

Twelve circulars containing decisions of the courts in cases based on the twenty-eight hour law were issued during the year, and one each in cases based on the food and drugs act and the cattle-quarantine law. In several instances syllabi of the decisions have been prepared by this Office and submitted to the judges for approval in advance of publication, in order that these syllabi when published might have the sanction of the judges and thereby the added force so imparted to them.

The preparation of an annotated edition of the twenty-eight hour law was commenced during the latter part of the year, but had not been completed at its close. There have now been so many decisions on this act that it was deemed important, if not necessary, to collate them in one pamphlet for the convenience of the Department, United States attorneys, the courts, and those most vitally affected by the act.

STATE OF OFFICE WORK.

The increase of the volume of work will require an addition to the force. The services of two additional law clerks and two stenographers are absolutely necessary at the present time.

In presenting to the court several letters received from attorneys for the claimants in one of the food and drug cases lately pending in the northern district of West Virginia, urgently requesting continuance of the case to a subsequent term of court, the United States attorney for that district, addressing the court, said that he could not consent to the continuance for the reason that the Secretary of

Agriculture is the most insistent of all the heads of the Departments in Washington upon prompt and vigorous enforcement of the laws committed to him for administration, and that if the court granted the continuance it would have to be done in spite of his protestation, and would without doubt involve him in several letters of explanation to the Secretary in answer to demands for the reasons for the continuance.

It is the desire to continue to deserve such compliments and to keep the legal work of the Department up to the minute, which prompts the request for the additional help necessary to accomplish that result.

The employees of the Office are competent, painstaking, and willing, and have expended upon their work extra efforts and additional hours in an earnest endeavor to keep it up to date. However, a portion of the less important work has not been kept strictly up to date. This is a condition very much to be regretted and can not be improved with the present force; indeed, a steady continuance of the present excessive amount of overtime is incompatible with that degree of care and skill required by the character of work of the Office.

REPORT OF THE APPOINTMENT CLERK.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE APPOINTMENT CLERK,
Washington, D. C., September 25, 1909.

SIR: I have the honor to submit herewith my annual report respecting appointments, promotions, reductions, removals, and other changes among the working force of the entire U. S. Department of Agriculture during the fiscal year ending June 30, 1909, and also containing matter respecting the officers and employees in the several Offices, Bureaus, and Divisions constituting the body of the Department of Agriculture as it existed on July 1, 1909.

Very respectfully,

J. B. BENNETT,
Appointment Clerk.

Hon. JAMES WILSON,
Secretary of Agriculture.

CHANGES IN THE FORCE OF THE DEPARTMENT.

Summary of appointments, promotions, removals, etc., in the United States Department of Agriculture during the fiscal year ended June 30, 1909.

IN THE CLASSIFIED SERVICE.

Number of persons appointed from the eligible registers of the Civil Service Commission for a probationary period of six months, equivalent to absolute appointment if retained in the service at the termination of the said probationary period	1,492
Number of persons who have been reinstated in the service of the Department within one year after having resigned or having been separated therefrom	52
Number of persons transferred from other Departments of the United States Government to the United States Department of Agriculture	61
Number of persons promoted in salary	1,765
Number of persons reduced in salary	105
Number of temporary or emergency appointments in the classified civil service, in accordance with civil-service rules, for periods of six months or less, for service in Washington, D. C., and who are separated from the service when the emergency that caused their appointments has ended, generally within one month and rarely continuing six months	626
Number of temporary or emergency appointments in the classified civil service, in accordance with civil-service rules, for periods of six months or less, conditioned as above, in the forests and fields and on stations in the various States outside of Washington, D. C	2,673
Number of persons who declined to accept appointments in the Department.	93
Number of persons who resigned their positions in the Department	511
Number of persons who were removed from the service of the Department because of their misconduct	53
Number of persons who died while in the service of the Department	38

IN SPECIAL POSITIONS EXCEPTED FROM EXAMINATION UNDER CIVIL-SERVICE RULES.

Number of persons appointed to positions which are in the classified civil service, but which are excepted from civil-service examination according to civil-service rules, the appointments being for very temporary periods and for service in Washington, D. C	1,417
Number of persons appointed to positions which are in the classified civil service, but which are excepted from civil-service examination according to civil-service rules, the appointments being for very temporary periods and for service in the forests and fields or on stations in the various States outside of Washington, D. C	1,206

IN THE UNCLASSIFIED SERVICE (POSITIONS OF MERE MANUAL LABORER).

Appointments in the District of Columbia	20
Promotions in salary in the District of Columbia	46
Reductions in salary in the District of Columbia	14
Separations from the service in the District of Columbia	16
Number of persons appointed in the forests and fields and on stations in the various States outside of Washington, D. C., being in the manual-laborer grade, the appointments being for very short periods, usually averaging not more than three months	16,938
Number of temporary or emergency appointments in the manual-laborer grade in the District of Columbia	61

TOTAL NUMBER OF APPOINTMENTS OF EVERY DESCRIPTION.

Total number of appointments of every description, including those for service in Washington, D. C., and those for service outside of Washington, D. C., in cattle and meat inspection, on forest reserves, on experiment stations and experiment farms, in moth and cotton boll weevil extermination, etc., which were of a temporary character and for a limited period	24,494

DEATHS IN THE DEPARTMENT OF AGRICULTURE.

During the fiscal year ended June 30, 1909, there were recorded 38 deaths among the officers and employees of the entire United States Department of Agriculture, as shown in the following table:

Name.	State.	Position.	Bureau, Division, or Office.	Salary.	Date of death.	Age.
					1908.	
William S. Canatsey [a] [b]	Kans.	Messenger	Entomology	$840	June 10	65
Colman Brez [a]	D. C.	Mechanic	Office Secretary	900	Aug. 12	44
William Jones [a]	...do	Unskilled laborer	Weather Bureau	660	Sept. 6	38
Waverly H. Reeves	Ohio	Skilled laborer	Animal Industry	720	Sept. 16	30
David Keller [a]	Pa.	Messenger	Weather Bureau	450	Sept. 22	64
Maurice L. Pease	Cal.	Deputy forest ranger	Forest Service	1,000	Sept. 30	31
Daniel L. De Saussure	S. C.	Collaborator	Plant Industry	1	Oct. 15	70
Jacob Adams [a]	Ohio	Skilled laborer	Div. Publications.	600	Oct. 21	66
Henry M. Edsall [a]	Ind.	Clerk	Animal Industry	1,400	Nov. 3	36
Louis W. Flege	N. Y.	Meat inspector	.....do	1,000	Nov. 8	24
John M. Twoomey [a]	D. C.	Skilled laborer	Div. Publications.	600	Nov. 15	49
Alfred Hawkins [a]	Md.	Assistant messenger	Office Secretary	720	Nov. 21	54
James Leatham	Utah	Deputy forest ranger	Forest Service	1,100	Nov. 27	44
William L. Davis	Tex.	Messenger boy	Weather Bureau	360	Nov. 29	16
Oliver E. Melvin	Wash.	Laborer	Animal Industry	[c] 2	Dec. 4	70
George S. Hickox	Nebr.	Agent and expert in charge of the eradication of scabies in sheep and cattle.	.....do	1,800	Dec. 29	68
					1909.	
Hugh H. Harris	N. Mex	Forest supervisor	Forest Service	1,700	Jan. 4	30
Edward R. Thompson	Md.	Copyist, topographic draftsman.	.....do	1,200	Jan. 6	22
Charles M. Conoyer	Nebr.	Clerk	Animal Industry	1,000	Jan. 29	67
William Eckl	N. Y.	Veterinary inspector	.....do	1,800	Jan. 31	45
William Alexander [a]	D. C.	Laborer	.....do	600	Jan. 31	75
Oliver F. Pray [a]	Mass.	Clerk	Chemistry	1,200	Feb. 3	22

[a] Stationed at Washington, D. C. (15).

[b] This death, which occurred near the close of the fiscal year 1908, was not chronicled in report for that year.

[c] Per diem.

Deaths in the Department of Agriculture—Continued.

Name.	State.	Position.	Bureau, Division, or Office.	Salary.	Date of death.	Age.
					1909.	
S. Helen Yonce [a]	N. C.	Clerk	Statistics	$1,200	Feb. 12	39
Jennie C. R. Murray [a]	D. C.	Charwoman	Entomology	[b]40	Mar. 17	35
Charles J. Bigley	Pa.	Clerk	Animal Industry.	1,200	Apr. 1	67
Charles Sindlinger	Ind.	Meat inspector	do	1,000	Apr. 7	52
John O. LaFontisse [a]	Fla.	Expert	Forest Service	1,500	Apr. 13	37
Harold R. Wade [a]	N. H.	Assistant Chemist	Chemistry	1,200	Apr. 18	32
John Adolp Stauffer	N. C.	Veterinary inspector	Animal Industry	1,800	May 13	43
Charles E. Wheeler	Conn.	Inspector's assistant	do	840	May 27	27
Martin J. Iorns	Iowa	Scientific assistant in horticulture.	Experiment Stations.	1,800	May 17	42
Sebastian E. Collins	Tex.	Inspector's assistant	Animal Industry	840	June 1	38
Basil T. Ridgeway [a]	Md.	Watchman	Office Secretary	720	June 5	76
Thomas F. Wheelen	Mass.	Meat inspector	Animal Industry	1,000	June 7	38
A. E. Wagner	Kans.	Stock examiner	do	1,200	June 21	68
William F. Fox	N. Y.	Collaborator	Forest Service	300	June 16	69
Eugene P. Courtney	Mont.	Assistant forest ranger	do	900	June 20	25
Charles E. Schoonover	do	Forest supervisor	do	1,500	Mar. 21	26

[a] Stationed at Washington, D. C. (15).

[b] Per month.

ESTABLISHMENT AND GROWTH OF THE DEPARTMENT OF AGRICULTURE.

The Department of Agriculture was established July 1, 1862, according to the provisions of an act approved May 15, 1862 (vol. 12, chap. 72, pp. 387, 388, U. S. Stat. L.).

Growth of the force of the Department from September 30, 1863, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
September 30, 1863	29	July 1, 1895	2,043
September 30, 1867	99	July 1, 1897	2,444
September 30, 1871	84	July 1, 1899	2,965
September 30, 1873	92	November 16, 1900	3,128
September 30, 1875	90	July 1, 1901	3,388
September 30, 1877	77	July 1, 1902	3,789
June 30, 1879	93	July 1, 1903	4,200
July 1, 1881	108	July 1, 1904	4,504
July 1, 1883	239	July 1, 1905	5,446
July 1, 1885	214	July 1, 1906	6,242
July 1, 1887	328	July 1, 1907	9,107
July 1, 1889	488	July 1, 1908	10,420
July 1, 1891 [a]	1,577	March 4, 1909	10,280
July 1, 1893	1,870	July 1, 1909	11,140

[a] The large increase on July 1, 1891, resulted from the transfer of the Weather Bureau to the Department of Agriculture on that date.

The following statements show the number and the increases in the number of persons employed in the various Bureaus, Divisions, Offices, and the Forest Service of the United States Department of Agriculture:

OFFICE OF THE SECRETARY.

Growth of total force employed from July 1, 1881, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	26	July 1, 1899	85
July 1, 1883	48	July 1, 1901	65
July 1, 1885	47	July 1, 1903	70
July 1, 1887	56	July 1, 1905	115
July 1, 1889	45	July 1, 1907	105
July 1, 1891	55	July 1, 1908	131
July 1, 1893	66	March 4, 1909	124
July 1, 1895	72	July 1, 1909	155
July 1, 1897	90		

Classification and number of persons in the Office of the Secretary, on July 1, 1909.

Classification.	Number.	Classification.	Number.
Secretary of Agriculture	1	Fireman	1
Assistant Secretary of Agriculture	1	Assistant firemen	3
Solicitor	1	Elevator conductors	4
Chief clerk and custodian of buildings	1	Construction inspector	1
Private secretary to Secretary of Agriculture	1	Mechanics	3
		Cabinetmaker	1
Stenographer and executive clerk to Secretary	1	Carpenter	1
		Painters	2
Stenographer to Assistant Secretary	1	Electrician	1
Appointment clerk	1	Electric wireman	1
Chief of supply division	1	Plumber	1
Inspector	1	Blacksmith	1
Law clerks	5	Skilled laborers	7
Clerks	35	Lieutenant of the watch	1
Telegraph and telephone operator	1	Watchmen	26
Messengers	4	Charwomen	11
Assistant messengers	4	Laborers	26
Messenger boy	1		
Chief engineer and captain of the watch	1	Total	155
Assistant engineers	3		

WEATHER BUREAU.

Growth of total force employed from July 1, 1891, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1891	818	July 1, 1903	1,410
July 1, 1893	921	July 1, 1905	1,540
July 1, 1895	892	July 1, 1907	1,694
July 1, 1897	1,075	July 1, 1908	1,705
July 1, 1899	1,163	March 4, 1909	1,535
July 1, 1901	1,185	July 1, 1909	1,825

Classification and number of persons in the Weather Bureau on July 1, 1909.

Classification.	Number.	Classification.	Number.
Chief of the Weather Bureau	1	Lithographers	4
Assistant Chief of Bureau	1	Proof reader	1
Professors of meteorology	9	Pressmen	2
Professor of meteorological physics	1	Folders and feeders	9
Inspectors	2	Repairmen	10
Chief of distribution division	1	Expert vessel reporter	1
Chief clerk	1	Station agents	3
Chiefs of divisions	4	Section directors	40
Librarian	1	Research director	1
Clerks	86	Observers	101
Copyists	5	Research observer	1
Architect and superintendent of construction	1	Special observer	1
		Evaporation observers	6
Chief mechanic	1	Assistant observers	199
Skilled mechanics	8	District forecasters	8
Engineer	1	Local forecasters	59
Electrician	1	Telegraph operator	1
Skilled artisans	6	Student assistants	7
Firemen	3	Special meteorological observers	22
Captain of the watch	1	Cotton-region observers[a]	143
Watchmen	4	Sugar and rice region observers[a]	9
Gardener	1	Corn and wheat region observers[b]	134
Skilled laborers	5	Special cranberry marsh observers	2
Messengers	32	Mountain snowfall observers	164
Messenger boys	108	Special river observers	336
Unclassified unskilled laborers	12	Special rainfall observers	35
Charwomen	4	Storm-warning displaymen	188
Assistant foremen of divisions	2		
Compositors	10	Total	1,825
Printers	26		

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[a] Cotton region observers and sugar and rice region observers make one observation a day from April 16 to October 31.

[b] Corn and wheat region observers make one observation a day from April 1 to September 30.

BUREAU OF ANIMAL INDUSTRY.

Growth of total force employed from July 1, 1885, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1885	24	July 1, 1901	1,286
July 1, 1887	61	July 1, 1903	1,386
July 1, 1889	174	July 1, 1905	1,475
July 1, 1891	334	July 1, 1907	3,182
July 1, 1893	495	July 1, 1908	3,152
July 1, 1895	709	March 4, 1909	3,251
July 1, 1897	777	July 1, 1909	3,268
July 1, 1899	1,106		

Classification and number of persons in the Bureau of Animal Industry on July 1, 1909.

Classification.	Number.	Classification.	Number.
Chief of Bureau	1	Stock examiners	236
Assistant Chief of Bureau	1	Field stock examiners	5
Chief clerk	1	Inspectors' assistants	355
Chief of biochemic division	1	Messengers	8
Chief of dairy division	1	Messenger boys	8
Chief of pathological division	1	Carpenters	8
Chief of zoological division	1	Cabinetmaker	1
Chief of quarantine division	1	Masons	2
Chief of inspection division	1	Masons' helpers	2
Associate chiefs of inspection division	3	Mechanic	1
Animal husbandman	1	Painters	4
Editor and compiler	1	Watchmen	2
Clerks	204	Plumber	1
Scientific assistants	16	Plumber's assistants	2
Miscellaneous scientists	94	Fireman	1
Agents	159	Charwomen	10
Experts	27	Skilled laborers	59
Veterinary inspectors	948	Unskilled laborers	68
Vessel inspectors	4		
Meat inspectors	1,026	Total	3,268
Live-stock inspectors	3		

BUREAU OF PLANT INDUSTRY.

Growth of total force employed from July 1, 1881, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	41	July 1, 1899	159
July 1, 1883	56	July 1, 1901	203
July 1, 1885	28	July 1, 1903	325
July 1, 1887	33	July 1, 1905	509
July 1, 1889	83	July 1, 1907	807
July 1, 1891	105	July 1, 1908	976
July 1, 1893	131	March 4, 1909	1,056
July 1, 1895	132	July 1, 1909	1,211
July 1, 1897	127		

Classification and number of persons in the Bureau of Plant Industry on July 1, 1909.

Classification.	Number.
Plant Physiologist and Pathologist and Chief of Bureau	1
Physiologist and Pathologist and Assistant Chief of Bureau	1
Chief clerk	1
Editor	1
Officer in charge of records	1
Agrostologist and special agent	1
Systematic agrostologist	1
Assistant agrostologist	1
Agricultural explorers	2
Chemical biologists	4
Chemist aid	1
Pharmacognosist	1
Agriculturist in charge of farm management	1
Assistant agriculturists in farm management	14
Assistants in farm management	4
Agricultural technologist	1
Agrostologist in charge of introduction of forage crops	1
Assistant agrostologist in the introduction of forage crops	1
Agriculturist in charge of dry-land agriculture	1
Assistants in dry-land agriculture	5
Agriculturist in charge of western agricultural extension	1
Agriculturists in western agricultural extension	2
Arboriculturist in dry-land agriculture	1
Assistants in arboriculture	4
Botanist in charge of fiber investigations	1
Botanist in charge of seed-testing laboratories	1
Botanist in charge of taxonomic investigations	1
Botanists and botanical assistants	9
Assistant curator in taxonomic investigations	1
Bionomist in crop acclimatization	1
Cerealist in charge of cereal investigations	1
Executive assistant in cereal investigations	1
Agronomist in charge of experiments with dry-land cereals	1
Agronomist in charge of oat investigations	1
Agronomist in charge of barley investigations	1
Agronomists	3
Crop technologist in charge of grain standardization	1
Assistants in grain standardization	19
Crop technologist in charge of tobacco investigations	1
Crop technologists assisting in tobacco investigations	3
Pathologist in charge of pathological laboratory	1
Mycologist	1
Pathologist in charge of investigation of fruit diseases	1
Pathologist in charge of cotton and truck diseases	1
Pathologist in charge of cereal-disease work	1
Pathologist in charge of forest pathology	1
Pathologist in charge of sugar-plant investigations	1
Assistants in sugar-plant investigations	2
Assistant pathologists	8
Physiologist in charge of crop physiology	1
Physiologist in charge of bacteriology and nutrition	1
Physiologist in charge of investigations of drug and poisonous plants, and tea-culture investigations	1
Physiologist in charge of corn investigations	1
Physiologist in charge of resistant plants	1
Physiologists and assistant physiologists	11
Physicist in charge of physical laboratory	1
Assistants in physical laboratory	3
Pomologist in charge of pomological collections	1
Pomologist in charge of field investigations	1
Pomologist in charge of fruit transportation and storage	1
Pomologist in charge of viticultural investigations	1
Pomologist in charge of fruit and district investigations	1
Pomologist in charge of South Texas Garden	1
Viticulture superintendent in pomological investigations	1
Assistant pomologists	3
Horticulturist in charge of Arlington Farm and horticulture	1
Horticulturist on Arlington Farm	1
Seed superintendent and clerk	1
Farm superintendent in grain investigations	1
Farm superintendents in western agricultural extension	3
Superintendent of testing gardens, Arlington Farm	1
Superintendent of gardens and grounds, Arlington Farm	1
Assistant superintendent of testing gardens in Congressional seed distribution	1
Superintendent of weighing and mailing in Congressional seed distribution	1
Assistant superintendents of seed warehouse and seed distribution	2
Inspector of seed warehouse and seed distribution	1
Special assistants in Congressional seed distribution	4
Assistant in charge of pathological and physiological plant houses and Department grounds	1
Collaborators	278
Experts	55
Special agents	229
Scientific assistants	65
Clerks	161
Laboratory aids and helpers	23
Photographers and artists	4
Mechanicians	4
Cabinetmaker	1
Carpenters	2
Painter	1
Plumber	1
Blacksmith	1
Skilled laborers	31
Gardeners	31
Gardener assistants	7
Messengers	3
Messenger boys	18
Charwomen	10
Unclassified manual laborers	122
Total	1,211

FOREST SERVICE.

Growth of total force employed from July 1, 1880, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1880	1	July 1, 1897	14
July 1, 1881	2	July 1, 1899	54
July 1, 1883	4	July 1, 1901	192
July 1, 1885	3	July 1, 1903	297
July 1, 1887	7	July 1, 1905	939
July 1, 1889	7	July 1, 1907	2,012
July 1, 1891	10	July 1, 1908	2,753
July 1, 1893	10	March 4, 1909	2,534
July 1, 1895	10	July 1, 1909	2,881

Classification and number of persons in the Forest Service on July 1, 1909.

Classification.	Number.	Classification.	Number.
Forester and Chief of Forest Service	1	Forest grazing assistants	2
Associate Forester	1	Game wardens	2
Assistant foresters	11	Plant ecologist	1
District foresters	6	Forest planting assistants	10
Deputy district foresters	6	Forest assistants	132
Chief of the office of accounts	1	Forest rangers	173
District fiscal agents	7	Deputy forest rangers	436
Law officer	1	Assistant forest rangers	581
Assistant law officer	1	Forest guards	485
Law examiners	15	Lumbermen	18
Land law clerks	13	Scalers	3
Law clerks	5	Miner	1
Clerks	426	Draftsmen	29
Property auditor	1	Map colorists	7
Chief of engineering	1	Copyist	1
Engineers in timber testing	7	Artist	1
Assistants in timber testing	5	Photographers	4
Engineers in wood preservation	4	Lithographer	1
Engineer in forest products laboratory	1	Lithographer's helper	1
Assistants in wood chemistry laboratory	4	Geographer	1
		Topographer	1
General laboratory aids, helpers, and assistants	5	Collaborators	20
		Compiler	1
Superintendents of telephone construction	2	Reader	1
Engineers in telephone construction	7	Forest students	2
Telephone lineman and repairman	1	Messengers	23
Electrician	1	Messenger boys	15
Experts of various classes	44	Carpenters	3
Agents of various classes	26	Painter	1
Chiefs and assistant chiefs of offices	50	Skilled laborers	4
Forest supervisors	126	Apprentice boys	2
Deputy forest supervisors	90	Unskilled laborers	8
Chiefs of sections	8	Janitor	1
General inspectors	2	Charwomen	13
Assistant inspectors	3	Watchmen	5
Forest examiners	9		
Inspector of forest grazing	1	Total	2,881

NOTE.—The National Forests under the control and supervision of the Forest Service on July 1, 1909, contained 194,505,325 acres.

BUREAU OF CHEMISTRY.

Growth of total force employed from July 1, 1881, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	8	July 1, 1899	26
July 1, 1883	11	July 1, 1901	29
July 1, 1885	8	July 1, 1903	50
July 1, 1887	13	July 1, 1905	97
July 1, 1889	20	July 1, 1907	250
July 1, 1891	27	July 1, 1908	425
July 1, 1893	24	March 4, 1909	454
July 1, 1895	24	July 1, 1909	475
July 1, 1897	20		

Classification and number of persons in the Bureau of Chemistry on July 1, 1909.

Classification.	Number.
Chemist, Chief of Bureau and chairman of board of food and drug inspection	1
Associate Chemist and member of board of food and drug inspection	1
Assistant Chief of Bureau and chief of division of foods	1
Assistant chief of division of foods	1
Chief of drug division	1
Chief of miscellaneous divisions	1
Chief of food inspection laboratory	1
Chief of animal physiological laboratory	1
Chief of vegetable physiological laboratory	1
Chief of dairy laboratory	1
Chief of leather and paper laboratory	1
Chief of contracts laboratory	1
Chief of cattle food and grain laboratory	1
Chief of micro-chemical laboratory	1
Chief of oil, fat, and wax laboratory	1
Chief inspector	1
Chief of food and drug inspection laboratory at Philadelphia, Pa	1
Chief of food and drug inspection laboratory at New York, N. Y	1
Chief of food and drug inspection laboratory at San Francisco, Cal	1
Chief of food and drug inspection laboratory at New Orleans, La	1
Chief of food and drug inspection laboratory at Denver, Colo	1
Chief of food and drug inspection laboratory at St. Paul, Minn	1
Chief of food and drug inspection laboratory at Boston, Mass	1
Chief of food and drug inspection laboratory at Chicago, Ill	1
Chief of food research laboratory at Philadelphia, Pa	1
Scientific assistants	30
Micro-analysts	4
Physiological chemists	2
Fermentation chemists	3
Food and drug inspection chemists	28
Bacteriological chemists	3
Food inspection chemist	1
Assistant chemists	85
Collaborating chemists	29
Chemist aids	3
Pharmacologist	1
Pharmacognosist	2
Food and drug inspectors	37
Drug inspector	1
Laboratory assistants and helpers	60
Laboratory glass blower	1
Experts	5
Special agents	8
Artist	1
Clerks	85
Skilled mechanic	1
Toolmaker	1
Electrical engineer	1
Stationary steam engineer	1
Firemen	2
Messengers	6
Messenger boys	2
Skilled laborer	1
Unskilled laborers	9
Janitor	1
Charwomen	4
Total	443
Board of consulting scientific experts to the Secretary of Agriculture	5
Experts to the board	17
Special agents to the board	9
Clerk and stenographer to the board	1
Total	32
Total in Bureau of Chemistry	475

BUREAU OF SOILS.

Growth of total force employed from July 1, 1895, to July 1, 1909.

Date.	Number employed.
July 1, 1895	10
July 1, 1897	33
July 1, 1899	15
July 1, 1901	57
July 1, 1903	130
July 1, 1905	130
July 1, 1907	116
July 1, 1908	118
March 4, 1909	126
July 1, 1909	142

Classification and number of persons in the Bureau of Soils on July 1, 1909.

Classification.	Number.
Soil Physicist and Chief of Bureau	1
Chief clerk	1
Scientists in soil survey	78
Expert in soil erosion or wash, and sedimentation	1
Expert in tobacco soil	1
Inspector in soil survey	1
Collaborators	16
Clerks	22
Laboratory helpers	2
Draftsmen	2
Photographer	1
Soil bibliographer	1
Publicity agent	1
Special agents	5
Mechanician	1
Carpenter	1
Messenger	1
Messenger boy	1
Charwoman	1
Unskilled laborers	4
Total	142

BUREAU OF ENTOMOLOGY.

Growth of total force employed from July 1, 1881, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	4	July 1, 1899	23
July 1, 1883	15	July 1, 1901	26
July 1, 1885	20	July 1, 1903	24
July 1, 1887	4	July 1, 1905	88
July 1, 1889	31	July 1, 1907	281
July 1, 1891	28	July 1, 1908	440
July 1, 1893	25	March 4, 1909	513
July 1, 1895	20	July 1, 1909	437
July 1, 1897	21		

Classification and number of persons in the Bureau of Entomology on July 1, 1909.

Classification.	Number.	Classification.	Number.
Entomologist and Chief of Bureau	1	Entomological preparators	6
Entomologist and Assistant Chief of Bureau	1	Assistant preparators	2
Executive assistant	1	Scientific assistants	2
Chief clerk	1	Student assistant	1
Entomologist in charge of breeding experiments	1	Entomological draftsman	1
Assistant in charge of breeding experiments	1	Artist	1
Entomological assistants	10	Agents and experts	57
Assistant in charge of southern field crop insects and tick investigations	1	Special experts	7
Assistant in charge of forest insect investigations	1	Special agents	16
Assistant in charge of deciduous-fruit insect investigations	1	Collaborators	13
Assistant in charge of cereal and forage-plant insect investigations	1	Clerks	18
Assistant in charge of apicultural investigations	1	Messengers	2
		Unskilled laborers	5
		Charwomen	3
		Foremen	31
		Tool keepers	2
		Laborers	249
		Total	437

BUREAU OF BIOLOGICAL SURVEY.

Growth of total force employed from July 1, 1887, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1887	6	July 1, 1901	21
July 1, 1889	9	July 1, 1903	30
July 1, 1891	13	July 1, 1905	37
July 1, 1893	14	July 1, 1907	38
July 1, 1895	19	July 1, 1908	45
July 1, 1897	23	March 4, 1909	49
July 1, 1899	23	July 1, 1909	54

Classification and number of persons in the Bureau of Biological Survey on July 1, 1909.

Classification.	Number.	Classification.	Number.
Chief of Bureau	1	Assistant biologists	7
Administrative assistant	1	Experts	6
Assistant in charge of biological investigations	1	Clerks	9
Assistant in charge of economic investigations	1	Messenger	1
Assistant in charge of game preservation	1	Charwoman	1
Assistant in charge of economic ornithology	1	Laborer	1
Chief field naturalist	1	Special inspectors of foreign animals and birds	4
Field naturalist	1	Game wardens	12
Assistant ornithologist	1	Assistant game wardens	3
Scientific assistant	1	Total	54

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Growth of total force employed from July 1, 1881, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	2	July 1, 1899	10
July 1, 1883	3	July 1, 1901	12
July 1, 1885	3	July 1, 1903	16
July 1, 1887	3	July 1, 1905	22
July 1, 1889	9	July 1, 1907	31
July 1, 1891	11	July 1, 1908	34
July 1, 1893	11	March 4, 1909	34
July 1, 1895	10	July 1, 1909	41
July 1, 1897	10		

Classification and number of persons in the Division of Accounts and Disbursements on July 1, 1909.

Classification.	Number.	Classification.	Number.
Chief of Division and Disbursing Clerk	1	Custodian of records and files	1
Assistant Chief of Division	1	Messenger	1
Auditors	2		
Cashier and chief clerk	1	Total	41
Clerks	34		

DIVISION OF PUBLICATIONS.

Growth of total force employed from July 1, 1881, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	1	July 1, 1899	81
July 1, 1883	3	July 1, 1901	142
July 1, 1885	3	July 1, 1903	154
July 1, 1887	5	July 1, 1905	166
July 1, 1889	9	July 1, 1907	182
July 1, 1891	30	July 1, 1908	188
July 1, 1893	22	March 4, 1909	192
July 1, 1895	21	July 1, 1909	193
July 1, 1897	61		

Classification and number of persons in the Division of Publications on July 1, 1909.

Classification.	Number.	Classification.	Number.
Editor and Chief of Division	1	Forewomen	2
Editor and Assistant Chief of Division	1	Clerks	82
Chief clerk	1	Chief folder	1
Associate editor	1	Folders	4
Assistants in charge of sections	3	Skilled laborers	51
Assistant editors	6	Messengers	15
Indexer	1	Fireman	1
Draftsmen	3	Charwomen	7
Photographers	7	Laborers	3
Assistant photographer	1		
Foremen	2	Total	193

BUREAU OF STATISTICS.

Growth of total force employed from July 1, 1881, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	3	July 1, 1899	132
July 1, 1883	86	July 1, 1901	145
July 1, 1885	66	July 1, 1903	151
July 1, 1887	95	July 1, 1905	155
July 1, 1889	82	July 1, 1907	149
July 1, 1891	100	July 1, 1908	181
July 1, 1893	111	March 4, 1909	161
July 1, 1895	85	July 1, 1909	159
July 1, 1897	133		

Classification and number of persons in the Bureau of Statistics on July 1, 1909.

Classification.	Number.	Classification.	Number.
Statistician	1	State statistical agents	45
Associate Statistician	1	Special agents	4
Assistant Statistician	1	Messengers	4
Chief clerk	1	Charwomen	3
Statistical scientists	4	Laborer	1
Clerks	76		
Clerk and special agent	1	Total	159
Special field agents	17		

LIBRARY.

Growth of total force employed from July 1, 1881, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1881	1	July 1, 1899	6
July 1, 1883	1	July 1, 1901	8
July 1, 1885	1	July 1, 1903	11
July 1, 1887	1	July 1, 1905	16
July 1, 1889	2	July 1, 1907	15
July 1, 1891	2	July 1, 1908	18
July 1, 1893	1	March 4, 1909	20
July 1, 1895	2	July 1, 1909	20
July 1, 1897	6		

Classification and number of persons in the Library on July 1, 1909.

Classification.	Number.	Classification.	Number.
Librarian	1	Messengers	3
Assistant Librarian	1	Charwoman	1
Translator	1		
Cataloguers	5	Total	20
Clerks	8		

OFFICE OF EXPERIMENT STATIONS.

Growth of total force employed from July 1, 1889, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1889	8	July 1, 1903	106
July 1, 1891	26	July 1, 1905	116
July 1, 1893	18	July 1, 1907	174
July 1, 1895	27	July 1, 1908	187
July 1, 1897	38	March 4, 1909	167
July 1, 1899	60	July 1, 1909	214
July 1, 1901	122		

Classification and number of persons in the Office of Experiment Stations on July 1, 1909.

Classification.	Number.	Classification.	Number.
Director of the Office	1	Editorial assistants	4
Assistant Director	1	Proof reader	1
Chief of editorial division	1	Agents and experts	4
Chief of division of insular stations	1	Experts	14
Chief of irrigation investigations	1	Special agents	4
Chief of drainage investigations	1	Agents	20
Chief clerk	1	Collaborators	2
Assistant in physiology and nutrition	1	Computer	1
Farmers' institute specialist	1	Clerks	31
Assistant farmers' institute specialist	1	Library assistant	1
Plant pathologist and entomologist	1	Copyist	1
Assistant animal husbandman	1	Gardener	1
Assistant agriculturists	1	Carpenter	1
Scientific assistants	13	Messengers	6
Specialist in agricultural education	1	Charwomen	6
Assistant in agricultural education	1	Chainmen	2
Supervising drainage engineers	4	Rodmen	11
Drainage engineers	6	Levelmen	3
Assistant drainage engineers	10	Mechanic	1
Irrigation managers	4	Axmen	11
Irrigation engineers	8	Laborers	10
Irrigation farmers	3	Teamsters	2
Office engineers	6	Cooks	4
Assistant office engineer	1		
Draftsman	1	Total	214
Editors	2		

OFFICE OF PUBLIC ROADS.

Growth of total force employed from July 1, 1893, to July 1, 1909.

Date.	Number employed.	Date.	Number employed.
July 1, 1893	1	July 1, 1905	41
July 1, 1895	5	July 1, 1907	56
July 1, 1897	7	July 1, 1908	65
July 1, 1899	6	March 4, 1909	64
July 1, 1901	12	July 1, 1909	65
July 1, 1903	26		

Classification and number of persons in the Office of Public Roads on July 1, 1909.

Classification.	Number.	Classification.	Number.
Director of the Office	1	Assistant in road material laboratory	1
Assistant Director	1	Laboratory apprentice	1
Chief engineer	1	Petrographer	1
Chief clerk	1	Scientific assistants	2
Chief of road management	1	Clerks	11
Senior assistant in road management	1	Experts	10
Superintendents of road construction	7	Special agents	4
Highway engineers	3	Photographer	1
Assistant highway engineer	1	Instrument maker	1
Junior highway engineers	6	Messenger	1
Assistant engineer	1	Messenger boys	2
Civil engineer student	1	Unskilled laborers	3
Testing engineer	1		
Chemist in road materials	1	Total	65

PLACE OF EMPLOYMENT.

The number of officers and employees in the different branches of the United States Department of Agriculture stationed in Washington, D. C., and the number employed outside of Washington, D. C., on July 1, 1909, was as follows:

Branch of the Department.	Number of officers and employees.		
	In Washington, D. C.	Outside of Washington, D. C.	Total.
Office of the Secretary	155		155
Weather Bureau	204	1,621	1,825
Bureau of Animal Industry	297	2,971	3,268
Bureau of Plant Industry	511	700	1,211
Forest Service	299	2,582	2,881
Bureau of Chemistry	230	245	475
Bureau of Soils	70	[a] 72	142
Bureau of Entomology	64	373	437
Bureau of Biological Survey	30	24	54
Division of Accounts and Disbursements	41		41
Division of Publications	193		193
Bureau of Statistics	93	66	159
Office of Experiment Stations	77	137	214
Library	20		20
Office of Public Roads	33	32	65
Total	2,317	8,823	11,140

[a] Employed outside of Washington D. C., temporarily.

PAY-ROLL CLASSIFICATION OF OFFICERS AND EMPLOYEES.

The following statement shows the number of persons, on July 1, 1909, occupying statutory positions on what are known as the statutory rolls of the Department, being specific positions especially created by act of Congress making appropriations for the United States Department of Agriculture; also the total number of persons in the said Department paid from miscellaneous or lump-sum funds appropriated by act of Congress as aforesaid, in which specific positions are not created:

Officers and employees of the Department on statutory rolls and those paid from lump-sum funds July 1, 1909.

Bureau, Division, Office, etc.	On statutory rolls.	On lump-sum funds.	Total.
Office of the Secretary	155		155
Weather Bureau	187	1,638	1,825
Bureau of Animal Industry	99	3,169	3,268
Bureau of Plant Industry	209	1,002	1,211
Forest Service	60	2,821	2,881
Bureau of Chemistry	69	406	475
Bureau of Soils	30	112	142
Bureau of Entomology	24	413	437
Bureau of Biological Survey	11	43	54
Division of Publications	193		193
Bureau of Statistics	87	72	159
Office of Experiment Stations	38	176	214
Library	19	1	20
Office of Public Roads	15	50	65
Division of Accounts and Disbursements	41		41
Total	1,237	9,903	11,140

HEADS OF THE DEPARTMENT OF AGRICULTURE.

Table showing the name and length of service of each Commissioner and of each Secretary of Agriculture since the organization of the United States Department of Agriculture, July 1, 1862.

Name.	Rank.	Appointed under the administration of President—	When appointed.	Service terminated.
Isaac Newton	Commissioner	A. Lincoln	July 1, 1862	June 19, 1867
John W. Stokes	do	A. Johnson	June 23, 1867	Dec. 4, 1867
Horace Capron	do	do	Dec. 5, 1867	July 31, 1871
Frederick Watts	do	U. S. Grant	Aug. 1, 1871	June 30, 1877
Wm. G. Le Duc	do	R. B. Hayes	July 1, 1877	June 30, 1881
Geo. B. Loring	do	J. A. Garfield	July 1, 1881	Apr. 3, 1885
Norman J. Colman	do	G. Cleveland	Apr. 4, 1885	Feb. 12, 1889
Do	Secretary	do	Feb. 13, 1889	Mar. 6, 1889
J. M. Rusk	do	B. Harrison	Mar. 7, 1889	Mar. 6, 1893
J. Sterling Morton	do	G. Cleveland	Mar. 7, 1893	Mar. 5, 1897
James Wilson	do	W. McKinley	Mar. 6, 1897	
Do	do	do	Mar. 6, 1901	
Do	do	T. Roosevelt	Mar. 6, 1905	
Do	do	W. H. Taft	Mar. 5, 1909	

PRINCIPAL OFFICERS OF THE DEPARTMENT.

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1909.

OFFICE OF THE SECRETARY.

Position.	Name.	Salary per annum.
Secretary of Agriculture	James Wilson	$12,000
Assistant Secretary	Willet M. Hays	5,000
Solicitor	George P. McCabe	4,500
Chief clerk and custodian of buildings	Sylvester R. Burch	3,000
Private secretary to the Secretary of Agriculture	Jasper Wilson	2,500
Appointment clerk	Joseph B. Bennett	2,000
Private secretary to the Assistant Secretary of Agriculture.		1,600
Chief of supply division	Cyrus B. Lower	2,000
Chief engineer and captain of the watch	Lewis Jones	1,600

WEATHER BUREAU.

[Corner Twenty-fourth and M streets NW. Phone, West 164.]

Chief of Bureau	Willis L. Moore	$6,000
Assistant Chief	Henry E. Williams	3,000
Chief clerk	Daniel J. Carroll	2,250
In charge of—		
Climatological division	Prof. Frank H. Bigelow	3,000
Instrument division	Prof. Charles F. Marvin	3,000
Forecast division	Prof. Edward B. Garriott	3,000
River and flood service	Prof. Harry C. Frankenfield	3,000
Accounts	Edgar B. Calvert	2,500
Chiefs of division:		
Distributing	James Berry	2,750
Publications	John P. Church	2,000
Telegraph	Jesse H. Robinson	2,000
Marine meteorology	Henry L. Heiskell	2,000
Supplies	Robert Seyboth	2,000
Librarian	Charles F. Talman	2,000
In charge of forecast districts:		
Chicago, Ill	Prof. Henry J. Cox[a]	3,000
San Francisco, Cal	Prof. Alexander G. McAdie[a]	3,000
Portland, Oreg	Edward A. Beals[a]	2,400
New Orleans, La	Isaac M. Cline[a]	2,400
Denver, Colo	Frederick H. Brandenburg[a]	2,400

[a] Also climatological editor.

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1909—Continued.

WEATHER BUREAU—Continued.

Position.	Name.	Salary per annum.
District forecasters:		
Boston, Mass	John W. Smith	$2,400
Louisville, Ky	Ferdinand J. Walz[a]	2,400
Washington, D. C	Edward H. Bowie	2,400
Buffalo, N. Y	David Cuthbertson	2,400
St. Louis, Mo	J. Warren Smith[a]	2,400
Inspectors:		
Detroit, Mich	Norman B. Conger	2,500
Milwaukee, Wis	Henry B. Hersey	2,500
Climatological editors:		
Baltimore, Md	Prof. Cleveland Abbe	2,500
Atlanta, Ga	Charles F. von Herrmann	2,000
Des Moines, Iowa	George M. Chappel[b]	1,000
Houston, Tex	Bernard Bunnemeyer	2,000
Salt Lake City, Utah	Alfred H. Thiessen	1,800
Research staff, Mount Weather, Va.		
Executive officer in charge	Prof. Alfred J. Henry	3,000
In charge of—		
Physical laboratory	Prof. William J. Humphreys	3,000
Solar-radiation work	Prof. Herbert H. Kimball	2,500
Upper-air research	William R. Blair	2,000

BUREAU OF ANIMAL INDUSTRY.

Chief of Bureau	Alonzo D. Melvin	$5,000
Assistant Chief	Arthur M. Farrington	3,000
Chief clerk	Charles C. Carroll	2,000
Chiefs of division:		
Biochemic	Marion Dorset	3,500
Dairy	B. H. Rawl	2,500
Inspection	Rice P. Steddom	3,000
Pathological	John R. Mohler	3,500
Quarantine	Richard W. Hickman	2,750
Zoology	Brayton H. Ransom	2,500
Animal husbandman	George M. Rommel	2,500
Editor and compiler	James M. Pickens	2,000
Superintendent of experiment station	E. C. Schroeder	3,000

BUREAU OF PLANT INDUSTRY.

Administration.		
Pathologist and Physiologist and Chief of Bureau	Beverly T. Galloway	$5,000
Pathologist and Physiologist and Assistant Chief of Bureau.	Albert F. Woods	3,500
Chief clerk	James E. Jones	2,250
Editor	J. E. Rockwell	2,000
Pathology.		
Pathologist in charge of laboratory of plant pathology.	Erwin F. Smith	3,240
Pathologist in charge of investigations of fruit diseases.	Merton B. Waite	2,750
Pathologist in charge of cotton and truck crop disease investigations.	William A. Orton	2,250
Pathologist in charge of laboratory of forest pathology.	Haven Metcalf	2,460
Physiology.		
Physiologist in charge of crop physiology and breeding investigations.	Walter T. Swingle	3,000
Physiologist in charge of soil bacteriology and water purification investigations.	Karl F Kellerman	2,250
Bionomist in charge of bionomic investigations	O. F. Cook	2,750
Physiologist in charge of drug plant, poisonous plant, and tea culture investigations.	Rodney H. True	2,750

[a] Also climatological editor.

[b] Receives additional compensation from State.

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1909—Continued.

BUREAU OF PLANT INDUSTRY—Continued.

Position.	Name.	Salary per annum.
Technology.		
Agricultural technologist in charge of crop technology investigations.	Nathan A. Cobb	$3,000
Botanist in charge of fiber investigations	Lyster H. Dewey	2,500
Crop technologist in charge of grain standardization	John D. Shanahan	3,000
Physicist in charge of physical laboratory	Lyman J. Briggs	2,750
Botanist in charge of seed laboratory	Edgar Brown	2,250
Agronomy.		
Cerealist in charge of grain investigations	Mark A. Carleton	3,000
Physiologist in charge of tobacco and nutrition investigations.	W. W. Garner	1,800
Physiologist in charge of alkali and drought resistant plant breeding investigations.	Thomas H. Kearney	2,500
Physiologist in charge of corn investigations	Charles B. Hartley	1,800
Pathologist in charge of sugar plant investigations	Charles O. Townsend	2,750
Botanist in charge of taxonomic and range investigations.	Frederick V. Coville	3,240
Demonstrations.		
Agriculturist in charge of farm management investigations.	W. J. Spillman	3,500
Special agent in charge of farmers' cooperative demonstration work.	Seaman A. Knapp	3,480
Agriculturist in charge of dry land agriculture investigations.	E. C. Chilcott	2,750
Agriculturist in charge of western agricultural extension.	Carl S. Scofield	2,760
Horticulture.		
Horticulturist in charge of Arlington Farm and horticulture.	L. C. Corbett	3,000
Superintendent of vegetable testing gardens	W. W. Tracy, sr.	3,000
Pomologist in charge of pomological collections	G. B. Brackett	3,000
Pomologists in charge of field investigations in pomology.	G. Harold Powell Wm. A. Taylor	3,000 3,000
Assistant in charge of pathological and physiological plant houses and Department grounds.	E. M. Byrnes	1,800
Seeds.		
Agricultural explorer in charge of foreign seed and plant introduction.	David Fairchild	2,750
Agrostologist in charge of forage crop investigations	C. V. Piper	2,750
Assistant in general charge of seed distribution	Leon M. Estabrook	2,250
Field gardens.		
Pomologist in charge of South Texas Garden, Brownsville, Tex.	Edward C. Green	2,280
Botanist in charge of Plant Introduction Garden, Chico, Cal.	W. W. Tracy, jr.	1,800

FOREST SERVICE.

[Atlantic Building, 928–930 F street. Phone Main 3572.]

Forester and Chief	Gifford Pinchot	$5,000
Associate Forester	Overton W. Price	3,500
Editor	Herbert A. Smith	3,000
Chief of publications	Findley Burns	1,800
Chief of information	Raymond W. Pullman	2,400
Dendrologist	George B. Sudworth	2,700
Assistant forester in charge of forest statistics	Royal S. Kellogg	2,300
Expert lumberman	Eugene S. Bruce	3,000
Branch of operation.		
Assistant forester, in charge	James B. Adams	3,200
Assistant forester	Chas. S. Chapman	2,500
Assistant in office methods	G. G. Anderson	2,000

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1909—Continued.

FOREST SERVICE—Continued.

Position.	Name.	Salary per annum.
Branch of operation—Continued.		
Office of accounts:		
Fiscal agent and chief	H. B. Cramer	$2,400
District fiscal agent	E. A. Melzar	2,000
Office of geography:		
Chief	F. G. Plummer	2,500
Office of maintenance:		
Chief	George A. Bentley	1,500
Branch of silviculture.		
Assistant forester, in charge	William T. Cox	2,800
Assistant forester	E. E. Carter	2,500
Office of Federal cooperation:		
Chief	A. B. Patterson	1,800
Office of State and private cooperation:		
Chief	J. G. Peters	1,700
Office of silvics:		
Chief	Raphael Zon	2,200
Librarian	Helen E. Stockbridge	1,260
Branch of products.		
Assistant forester, in charge	William L. Hall	3,000
Assistant forester	McGarvey Cline	2,000
Office of wood utilization:		
Chief	H. S. Sackett	1,400
Office of wood preservation:		
Chief	H. F. Weiss	1,700
Branch of grazing.		
Assistant forester, in charge	A. F. Potter	3,000
Assistant forester	L. F. Kneipp	2,200
DISTRICT OFFICES.		
District No. 1, Missoula, Mont.		
District forester	W. B. Greeley	2,200
Assistant district forester	F. A. Silcox	1,800
District law officer	W. M. Aiken	1,200
Office of operation:		
Chief	R. H. Rutledge	1,900
Office of silviculture:		
Chief	A. W. Cooper	2,000
Office of grazing:		
Chief	C. H. Adams	2,000
District No. 2, Denver, Colo.		
District forester	Smith Riley	2,200
Assistant district forester	P. G. Redington	2,000
District law officer	John M. Cates	1,500
Office of operation:		
Chief	Fred W. Morrell	1,600
Office of silviculture:		
Chief	A. K. Chittenden	2,400
Office of grazing:		
Chief	J. W. Nelson	1,900
Office of products:		
Chief	C. L. Hill	1,600
District No. 3, Albuquerque, N. Mex.		
District forester	A. C. Ringland	2,200
Assistant district forester	Earle H. Clapp	2,200
District law officer	H. B. Jamison	1,200
Office of operation:		
Chief	A. O. Waha	1,700
Office of silviculture:		
Chief	F. S. Woolsey, jr	1,800
Office of grazing:		
Chief	J. K. Campbell	1,800

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1909—Continued.

FOREST SERVICE—Continued.

Position.	Name.	Salary per annum.
District No. 4, Ogden, Utah.		
District forester	Clyde Leavitt	$2,200
Assistant district forester	F. W. Reed	2,100
District law officer	W. C. Henderson	1,400
Office of operation:		
Chief	R. P. Imes	1,800
Office of silviculture:		
Chief	L. L. White	1,700
Office of grazing:		
Chief	Homer E. Fenn	1,900
Supply depot, property clerk	A. M. Smith	1,800
Property auditor	J. G. Falck	1,700
District No. 5, San Francisco, Cal.		
District forester	F. E. Olmsted	3,000
Assistant district forester	Coert DuBois	2,400
District law officer	E. A. Lane	1,800
Office of operation:		
Chief	Roy Headley	1,600
Office of silviculture:		
Chief	G. M. Homans	2,000
Office of grazing:		
Chief	John H. Hatton	2,100
Office of products:		
Chief	C. S. Smith	1,600
District No. 6, Portland, Oreg.		
District forester	E. F. Allen	2,700
Assistant district forester	Geo. H. Cecil	2,000
District law officer	C. R. Pierce	1,800
Office of operation:		
Chief	C. H. Flory	1,700
Office of silviculture:		
Chief	F. E. Ames	1,600
Office of grazing:		
Chief	H. K. O'Brien	1,900
Office of products:		
Chief	J. B. Knapp	1,600

BUREAU OF CHEMISTRY.

Chemist and Chief of Bureau	H. W. Wiley	$5,000
Assistant Chief	W. D. Bigelow	3,500
Associate Chemist	F. L. Dunlap	3,500
Chief clerk	F. B. Linton	1,800
Editorial clerk	A. L. Pierce	1,800
Librarian	M. W. Taylor	1,600
Chief, Washington food-inspection laboratory	L. M. Tolman	3,000
Chief of food and drug inspection	Walter G. Campbell	2,500
Chief of dairy laboratory	G. E. Patrick	2,500
Chief of miscellaneous division	J. K. Haywood	2,750
Chief of drug division	L. F. Kebler	3,000
Chief of contracts laboratory	P. H. Walker	2,500
Chief of leather and paper laboratory	F. P. Veitch	2,500
Chief of micro-chemical laboratory	B. J. Howard	2,000
Acting chief of sugar laboratory	A. H. Bryan	2,000
Chief of food technology laboratory	E. M. Chace	2,500
Chief of drug inspection laboratory	G. W. Hoover	1,800
Chief of synthetic products laboratory	W. O. Emery	2,000
Acting chief of pharmacological laboratory	William Salant	2,500
Chief of water laboratory	W. W. Skinner	2,250
Chief of insecticide and fungicide laboratory	C. C. McDonnell	2,000
Chief of oil, fat, and wax laboratory	H. S Bailey	1,600
In charge of—		
Animal physiology	F. C. Weber	2,250
Vegetable physiology	J. A. Le Clerc	2,500
Bacteriological chemistry	G. W. Stiles, jr	2,000
Nitrogen section	T. C. Trescot	2,500
Consulting scientific expert to the Secretary of Agriculture and chairman of the referee board.	Dr. Ira Remsen	2,000
Consulting scientific expert to the Secretary of Agriculture.	Dr. Russell H. Chittenden	2,000
Do	Dr. Christian A. Herter	2,000
Do	Dr. John H. Long	2,000
Do	Dr. Alonzo E. Taylor	2,000

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1909—Continued.

BUREAU OF SOILS.

Position.	Name.	Salary per annum.
Chief of Bureau	Milton Whitney	$3,500
Chief clerk	A. G. Rice	2,000
In charge of—		
Soil survey	J. A. Bonsteel	3,250
Soil chemical and physical investigations	Frank K. Cameron	3,250
Soil fertility investigations	Oswald Schreiner	3,000
Soil erosion	W J McGee	3,000

BUREAU OF ENTOMOLOGY.

Entomologist and Chief of Bureau	L. O. Howard	$4,000
Entomologist and Acting Chief in Absence of Chief	C. L. Marlatt	3,000
Executive assistant	R. S. Clifton	2,250
Chief clerk	C. J. Gilliss	1,800
In charge of—		
Truck crop and stored product insect investigations	F. H. Chittenden	2,750
Forest insect investigations	A. D. Hopkins	2,750
Southern field-crop insect investigations	W. D. Hunter	2,750
Cereal and forage insect investigations	F. M. Webster	2,750
Deciduous-fruit insect investigations	A. L. Quaintance	2,750
Bee culture investigations	E. F. Phillips	2,500

BUREAU OF BIOLOGICAL SURVEY.

Biologist and Chief of Bureau	C. Hart Merriam	$3,000
Administrative assistant, Acting Chief in absence of Chief.	H. W. Henshaw	2,750
Assistants in charge of—		
Economic investigations	A. K. Fisher	2,500
Game preservation	T. S. Palmer	2,500
Biological investigations	Vernon Bailey	2,500

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Chief of Division and Disbursing Clerk	A. Zappone	$3,250
Assistant Chief of Division (in charge of Weather Bureau accounts).	E. B. Calvert	2,500
Chief clerk and cashier	M. E. Fagan	2,000
In charge of—		
Cashier's section	do	2,000
Auditing section "A"	E. D. Yerby	2,000
Auditing section "B"	A. W. Smith	2,000
Bookkeeper's section	F. W. Legge	1,800
Freight and transportation section	E. E. Forbes	1,800
Miscellaneous section	W. J. Nevius	1,800

DIVISION OF PUBLICATIONS.

Editor and Chief	Jos. A. Arnold	$3,000
Editor and Assistant Chief	B. D. Stallings	2,250
Chief clerk	A. I. Mudd	2,000
Associate Editor	Geo. Wm. Hill	2,000
Assistants in charge of—		
Document section	Robert B. Handy	2,000
Illustrations	L. S. Williams	2,000
Indexing	C. H. Greathouse	1,800

BUREAU OF STATISTICS.

Statistician and Chief of Bureau	Victor H. Olmsted	$3,500
Associate Statistician	Charles C. Clark	3,000
Assistant Statistician	Nat. C. Murray	2,500
Chief clerk	Samuel A. Jones	1,800
Statistical scientists in charge of divisions of—		
Production and distribution	George K. Holmes	3,000
Editorial and library	Charles M. Daugherty	2,500
Domestic crop reports	Fred. J. Blair	1,800

Principal officers of the several Bureaus, Divisions, and Offices of the Department of Agriculture on July 1, 1909—Continued.

LIBRARY.

Position.	Name.	Salary per annum.
Librarian	Claribel R. Barnett	$2,000
Assistant Librarian	Emma B. Hawks	1,400

OFFICE OF EXPERIMENT STATIONS.

Position.	Name.	Salary per annum.
Director	A. C. True	$4,000
Assistant, and editor of Experiment Station Record	E. W. Allen	3,000
Chiefs of—		
Editorial division	W. H. Beal	2,500
Division of insular stations	Walter H. Evans	2,500
Nutrition investigations	C. F. Langworthy	2,400
Irrigation investigations	S. Fortier	3,000
Drainage investigations	C. G. Elliott	3,000
In charge of—		
Alaska experiment stations	C. C. Georgeson	3,000
Hawaii Experiment Station	Earley V. Wilcox	3,000
Porto Rico Experiment Station	David W. May	3,000
Agricultural education specialist	D. J. Crosby	2,200
Farmers' institute specialist	John Hamilton	2,250
Chief clerk	Mrs. C. E. Johnston	1,800

OFFICE OF PUBLIC ROADS.

Position.	Name.	Salary per annum.
Director	Logan W. Page	$3,000
Assistant Director	Allerton S. Cushman	3,000
Chief engineer	Vernon M. Peirce	2,500
Chief of road management	J. E. Pennybacker, jr	2,000
Testing engineer	Philip L. Wormeley	1,800
Chief clerk	W. Carl Wyatt	1,600

NUMBER OF OFFICERS AND EMPLOYEES IN THE U. S. DEPARTMENT OF AGRICULTURE ON MARCH 4, 1909, CLASSIFIED BY SEX AND PLACE OF EMPLOYMENT.

Number of males	9,177
Number of females	1,103
Total number of officers and employees in the entire Department of Agriculture on March 4, 1909	10,280
Males stationed in Washington, D. C	1,698
Females stationed in Washington, D. C	757
Total number stationed in Washington, D. C	2,455
Males stationed outside of Washington, D. C	7,479
Females stationed outside of Washington, D. C	346
Total number stationed outside of Washington, D. C	7,825

The cause of the decrease (140) in the number of officers and employees in the Department of Agriculture on March 4, 1909 (10,280), as compared with the number in the Department on July 1, 1908 (10,420), was the inclement weather prevailing during that season of the year preventing the performance of outdoor work in many sections of the country.

CIVIL-SERVICE REGULATIONS GOVERNING PROMOTIONS, ETC., IN THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Office of United States Civil Service Commission,
Washington, D. C., January 13, 1909.

In pursuance of the requirements of section 7 of "An act to regulate and improve the civil service of the United States," approved January 16, 1883, and in conformity with Rule XI of the revision of the civil-service rules, promulgated by the President on the 15th day of April, 1903, the following regulations governing promotions in the departmental service of the Department of Agriculture have been formulated by the Civil Service Commission after consultation with the Secretary of Agriculture and are hereby promulgated:

Regulation I.

Section 1. All vacancies above those in the lowest class of any grade not filled by reinstatement, transfer, or reduction shall be filled by promotion: *Provided,* That if there is no person eligible for promotion, or if the vacant position requires the exercise of technical or professional knowledge, it may be filled through certification by the Civil Service Commission.

Sec. 2. Except as provided in section 1 of this regulation, a vacancy in any class shall be filled by promotion of an eligible in the next lower class of the same Bureau, Division, or Office.

Regulation II.

Section 1. No person shall be promoted to any grade from which he is barred by the age limitations prescribed by the civil-service rules.

Sec. 2. No person whose record of efficiency is below 85 per cent of the possible maximum rating of his class or grade shall be eligible for promotion.

Sec. 3. No person occupying a position below the grade of clerk-copyist shall be promoted to that grade until he shall have been employed two years in the departmental service and shall have passed, with an average percentage of 77 or over, the examination prescribed by the Commission.

Regulation III.

Section 1. The chief clerk of each Bureau, under the direction of the head thereof, shall keep a record of the efficiency of all employees under his supervision, and a similar record of employees not assigned to any Bureau shall be kept by the Chief Clerk of the Department.

Sec. 2. The record of efficiency shall be kept on such forms as may be prescribed by the Commission after consultation with the Secretary of Agriculture, and shall embrace the elements which are essential to a fair and accurate determination of the relative merits of employees.

Sec. 3. The efficiency reports made by the chiefs of the several Bureaus, Divisions, and Offices of the Department of Agriculture, respecting the value of the personal services in the Department of each person serving under them, and filed with the Appointment Clerk for the Secretary of Agriculture, shall be the basis of all promotions, demotions, and continuations on the rolls of the Department.

Sec. 4. The following shall be the form of efficiency report to be used in the Department of Agriculture:

United States Department of Agriculture,
Office of the Secretary,
Washington, D. C., January 13, 1909.

EFFICIENCY REPORT.

To the Chiefs of Bureaus, Divisions, Offices, etc.:

The chief of each Bureau, independent Division, or Office will report annually, on the 1st day of May, concerning the employees under his supervision as required by the form below, and he is expected to see that the ratings are made after due consideration of all the factors applicable to the individual case. Additional reports may be submitted by chiefs of Bureaus if found necessary.

It should be borne in mind that in determining the relative efficiency of employees comparison will be made between those of the same grade or doing the same or similar kinds or grades of work. In determining the ratings, the degrees of excellence adopted as the standard should not be an impossible one, but one which can be attained by a capable person, and the employee whose work fulfills the requirements of this standard should be given the maximum rating.

The ratings will be indicated by a mark (x) in the appropriate space and by such additional remarks as may be deemed desirable.

James Wilson,
Secretary of Agriculture.

Department of Agriculture,
May 1, 190—.

Bureau of....................
Name of employe.. Station..................
Official designation.. Salary, $.......

Character of Work.

Class 1: Administrative, executive, supervisory..............	....	Class 2: Scientific, technical, professional..............	....

If the duties of employee place him in one or both of the preceding classes, indicate the relative degree in which the following requirements are involved:

	High.	Moderate.	Small.
Special ability, knowledge, training, experience..............	....	....	....
Exercise of judgment, discrimination, discretion..............	....	....	....
Original thought, consideration, investigation..............	....	....	....
Responsibility..............	....	....	....

Class 3: Clerical..............	....	Class 4: Skilled trades..............	....
Class 5: Special occupations..............	....	Class 6: Skilled laborers, watchmen, messengers..............	....

If the employee is in one of the four groups last above named, indicate the grade of work.

Largely supervisory, or requiring highest order of ability, involving much original thought, consideration, and investigation..............	....
More or less routine, involving responsibility, special ability, and original thought, consideration, and investigation..............	....
Routine, requiring but little original thought or consideration, but requiring judgment, responsibility, and special skill..............	....
Simple or routine work, requiring care accuracy, and skill..............	....

If the work performed is that of an unskilled laborer, janitor, charwoman, indicate it here..............	....

Describe the work of the employee under consideration in sufficient detail to enable a reviewing office to compare it with that of others.

Quality of Work.

		Degrees of efficiency and relative value of terms.				
		Excellent, 96–100.	Very good, 91–95.	Good, 85–90.	Fair, 70–84.	Poor, under 70.
1 [a] [b]	Personality—ability to represent the Bureau creditably in its intercourse with other offices and the public..............	....	....	....	....	....
2 [a]	Scientific, technical, professional, or general ability and experience; ability to develop and direct lines of work; ability to obtain, interpret, and present results..............	....	....	....	....	....
3 [a] [b]	Capacity for administrative, executive, or supervisory duties..............	....	....	....	....	....
4	Capacity to perceive, devise methods, adapt means to ends, adopt suggestions, execute directions..............	....	....	....	....	....
5	Loyalty; conscientiousness; accuracy and reliability; extent to which the judgment, discernment, or decisions of the employee or the work done can be depended upon; promptness in carrying out instructions or in attending to routine work; willingness to take up new work or to do extra work; appearance of work done..............	....	....	....	....	....
	Considering all the factors applicable to the work of the employee, indicate the quality of his work viewed as a whole..............	....	....	....	....	....

---

[a] To be considered only in connection with classes 1 and 2 under "Character of work."

[b] To be considered only in connection with such of the employees included in classes 1 and 2 as may be occupying positions where the qualities mentioned are important.

REMARKS:

QUANTITY OF WORK.

In rating on quantity of work, consider industry, speed, attentiveness, energy, application, perseverance, amount of mental or manual labor required to produce results, or of time where that is the principal element.

	Terms of measurement and relative value.				
	Very large, 96–100.	Large, 91–95.	Average, 85–90.	Small, 70–84.	Very small, below 70.
Rating					

REMARKS:

ATTENDANCE AND DEPORTMENT.

	Degrees of satisfaction.		
	Very satisfactory.	Satisfactory.	Unsatisfactory.
Attendance: Consider punctuality; whether employee habitually takes excessive amount of sick leave or leave without pay; absence during official hours from desk or place of duty to detriment of work; absence without prior permission or prompt notification with reason therefor; overtime			
Deportment: Consider general demeanor and habits; disregard of or violation of rules and instructions; courtesy in official relations and personal intercourse with coworkers; interference with or annoyance to other employees; insubordination; inattention; negligence; indifference			

If the attendance or deportment has been unsatisfactory, state in what particular; if the employee has been admonished with regard to it, without improvement, so state.

REMARKS:

	Excellent, 96–100.	Very good, 91–95.	Good, 85–90.	Fair, 70–84.	Poor, under 70.
Considering the quality of work done by this employee, and his record for attendance and deportment, indicate how you would rate his services—that is, his general efficiency					

If you think this employee should be advanced or reduced in grade or salary, state to what grade or salary and give reasons:

Approved.

——— ———, *Chief of Bureau.*

Initials of marking officer ———.

SEC. 5. An examination into the relative efficiency of employees, as shown by the efficiency record hereinbefore provided for, and such further tests as the Commission may deem necessary, shall constitute an examination for promotion from one class to another class. No person, except as herein provided, shall be eligible for promotion until he shall have passed such an examination.

SEC. 6. Examinations for promotion from one grade to another grade shall be conducted by the board of promotion examiners at such times as may be fixed by the Commission.

SEC. 7. Efficiency report blanks shall be supplied to the chiefs of Bureaus, Divisions, and Offices by the Appointment Clerk for the Secretary of Agriculture, before the termination of the month of March each year, and may be submitted by chiefs of Bureaus, etc., or called for at such other times as the interests of the Department seem to require.

JOHN C. BLACK,
President United States Civil Service Commission.
JAMES WILSON,
Secretary of Agriculture.

Approved January 13, 1909.

ADDENDA.

EXECUTIVE ORDER.

The executive order made by President Roosevelt of date March 30, 1905, recites as follows:

> With the view that hereafter under no circumstances whatever shall any unclassified laborer be assigned to classified work, I direct that the additional laborers referred to as shown in reports already made to the Civil Service Commission be regarded as classified in the positions occupied by them on the date of this order, and that they may be promoted to the clerical grade or transferred in the manner provided by the civil-service rules and regulations.

It appears that in certain cases the work of various departments, independent offices, and bureaus is of such character that it can not be economically and conveniently done consistently with a rigorous adherence to the division between classified and unclassified work. In such cases unclassified laborers are engaged for the greater part of their time on unclassified work, but at the same time there is certain classified work which could be more economically and conveniently done if such laborers were permitted to do it incidentally, and not as a part of their main work or employment.

It is therefore ordered that hereafter where such a state of things exists as is above recited unclassified laborers may be assigned to classified work incidentally, but not as a part of their main work, in cases where such work can not be conveniently and economically done by classified employees, but never without the prior consent of the Civil Service Commission, obtained before such assignment, and with a view to the doing of the particular classified work in question by unclassified employees.

Wm. H. Taft.

The White House,
April 21, 1909.
(No. 1065.)

EXECUTIVE ORDER.

By reason of the small compensation usually paid to messenger boys upon entrance to the service, and by reason of the early age at which they are appointed, it has not been deemed proper to hold this examination for the departmental service at Washington away from the seat of government. The examination has been limited to Washington, D. C., but applicants, while actually located in the District of Columbia, have been able to establish legal residence in the various States in so many instances that the several States and Territories have been fairly represented in the apportionment of messenger boys. Legal residents of the District of Columbia have not been certified for the apportioned service. Under section 7 of the census act approved July 2, 1909, it will be necessary for applicants to actually reside in the State or Territory in which they are examined, and as it is deemed impracticable to hold messenger boy examinations outside of Washington, the examination will be limited by the census act to residents of the District of Columbia. If messenger boys were charged to the apportionment as heretofore, the excessive number of apportioned appointments already received by the District would be largely increased. In view of these facts, civil-service Rule VII, and civil-service Rule XI are hereby amended to provide for the appointment of messenger boys without charge to the apportionment.

Civil-service Rule VII, paragraph 2, is amended by adding the following words: "and messenger boy."

As amended, the paragraph will read as follows:

> 2. Certification for appointment in the departments or independent offices at Washington shall be so made as to maintain, as nearly as the conditions of good administration will warrant, the apportionment of such appointments among the several States and Territories and the District of Columbia upon the basis of population: *Provided,* That appointments to the following-named positions shall not be so apportioned, viz, plate printer, printer's assistant, skilled helper, and operative in the Bureau of Engraving and Printing; positions in the field service of the military staff departments and at army headquarters, mail-bag repair shop and mail-lock repair shop, Government Printing Office, pension agency, and local offices in the District of Columbia; apprentice, student, gardener, engraver, carpenter, cabinetmaker, painter, plumber, plumber's helper, electric wireman, electric lineman, electrician's helper, and messenger boy.

Civil-service Rule XI is amended by the addition of a new paragraph to be numbered 6, as follows:

> 6. Messenger boys appointed without regard to the apportionment shall not be promoted or transferred to apportioned positions whether they are residents of States or Territories which are entitled to appointments to apportioned positions or not.

This order is made upon the recommendation of the Civil Service Commission.

Wm. H. Taft.

The White House,
September 18, 1909.
(No. 1127.)

RESPECTING PLACES AND DATES OF EXAMINATIONS, AND DOMICILE OF APPLICANTS.

Circular amending Manual of July 1, 1909.

United States Civil Service Commission,
Washington, D. C., July 15, 1909.

In accordance with a recent act of Congress the following sections of the Manual of Examinations, revised to July 1, 1909, are amended as indicated below:

Sec. 1. The first paragraph is amended to read as follows:

> No request will be granted to take an examination at any place or on any date for which it is not scheduled. An applicant may take only one kind of examination at one time or place. An applicant is required to be examined in the State or Territory of which he is a legal resident.

SEC. 16. The first paragraph is amended to read as follows:

Every applicant must make oath in his application to the place of his legal residence, which must be shown continuously to the exact date of the application and be corroborated by the officer's certificate as required on the application. In the case of persons in the apportioned service in the executive departments at Washington the county officer's certificate is not required. Such persons should show on their applications, opposite the county officer's certificate, that they are so employed. The act of Congress referred to above provides that hereafter all examinations of applicants for positions in the Government service from any State or Territory shall be had in the State or Territory in which such applicant resides, and no person shall be eligible for such examination or appointment unless he or she shall have been actually domiciled in such State or Territory for at least one year previous to such examination.

SEC. 18. The first paragraph is amended to read as follows:

A person who has applied for an examination mentioned in section 1 and who desires to change the place and date given in his application to any other scheduled date and place in the State or Territory of which he is a legal resident, mentioned in section 1, may have such change made upon written request. No arrangements can be made to give an examination on a date or at a place other than one scheduled in the State or Territory of which the applicant is a legal resident.

INDEX.

Page.
Aaronsohn, Aaron, study of wild wheat in Palestine 69
Accounts and Disbursements, Division, estimates for 1910 561
growth of force, 1881–1909 800
report of Chief, 1909 553–590
review of work; officers 125–127, 809
1907, close 558–559
consolidation, recommendation 151
disbursements of Department in 1909 126
falsification case, disposal 776
settlement, 1907 126
Acetanilid, injurious effects, investigation, Bureau of Chemistry 101, 434–435, 437
Acetic acid, standard, difficulty of securing 431
Acetphenetedin (phenacetin), use in headache mixtures, investigations 435, 437
Acid. *See* Boric; Citric; Nitric; Sulphurous, etc.
Adams Act, funds allotted, notes 126, 127
Addiction, drug, investigation of dangers in "cures" 435–436
Addressing machines, use in the distribution of documents 605–606
Adulteration, beeswax 436
drugs, investigations 430–432, 450
food, definition 37
seed, Kentucky bluegrass and orchard grass, studies 292
turpentine, examination, Chemistry Bureau 443–444
Aerial observations, Mount Weather Observatory, 1909 155–156
Agricultural censuses, quinquennial, provision for by law 666
clubs, boys', cooperative promotion 688
colleges and schools. *See* Colleges; Schools.
experiment stations. *See* Experiment stations.
extension, western, office work 318–319
production, 1909, increase in value over previous years 9–10
products, foreign trade 14–15
value in 1909, increase over previous years, etc 9–10
See also Farm products.
Agriculture, benefits from distribution of Farmers' Bulletins 129
China, study and report 359
Department, appropriations, disbursements, etc., 1839–1909 567–590
estimates and expenditures, 1909, 1910, 1911 126–127, 554, 555–556, 560–564
civil-service regulations governing promotions, etc. ~~511–513~~ 8[illegible]
establishment and growth 793–802
heads, length of service, etc 804
legal operations, 1909 42–44
officers and employees, classification 803, 810
personnel, changes during 1909 45
principal officers, etc 804–810
property, conversion, prosecution of cases 775
publications, 1909 614–654
classified by Bureaus 592–594
output, 1907, 1908, 1909, comparison 594
work in 1909, review 34–150
dry-land, cooperative studies of environmental conditions 320–321
experimental work and stations 64–68
study of factors and methods 317
See also Dry farming.
study courses, reorganization and improvement 135, 136
of systems developed by farmers in semiarid regions 68

Page.
Air, upper, observations, Mount Weather 45–47, 155–156
Alabama, forest conditions study, cooperative work, 1909 398
Polytechnic Institute, Auburn, tick-eradication investigations 240
soil surveys, cooperation of State 477, 481
studies and demonstrations of alfalfa culture 323
tobacco work and studies 312–313
Alaska, Copper Center Station, transfer to Department of Interior 138
experiment station work, report 693, 694–696
review by Secretary 138–139
fruit-growing experiments at Sitka 696
game protection, 1909 ..... 124, 545
stock-breeding experiments, Kodiak Island 139
Alaska-Yukon-Pacific Exposition, exhibits from various Bureaus 149, 173, 409, 693, 696, 698, 714
Alcohol, denatured, investigations 415
manufacture, experimental school, Bureau of Chemistry 102
toxicity, pharmacological studies with small animals 438
Aleyrodes spp. *See* White fly.
Alfalfa, Arabian, seed distribution, study 364
cooperative studies and experiments 363–364
crossing experiments and results 356
cultivation, varieties, experiments 277–278
culture, studies and demonstrations in Alabama 323
damage by field mice, note 119
drought-resistant, importation of new varieties 358
varieties, experiments 278–279
Grimm, experiments in Northwest, and recommendations 277
growing, in arid regions, experiments 65–66
methods and experiments 66, 134
Peruvian, experiments in propagation in Arizona and California 278
seed production, cooperative experiments 364
Siberian, dry-land varieties, experiments and results 66, 68, 358–359
testing stations, experiments with varieties of alfalfa in Northwest and Canada 278
Alfalfas, hardy, experiments 364
Alkali resistance, plant-breeding studies and experiments 319–320
Alkaloids, investigations, Chemistry Bureau 446, 451
Almond, desert, study of dry-land stock in several States 276–277
extract, adulteration with hydrocyanic acid, prosecution 455
Analysis methods, studies, New York laboratory 459
Anastatus bifasciatus, shipment from Hungary 496
Andropogon spp., Indian oil-bearing grasses, studies 281
Anemia, infectious, of horses, studies and experiments 59–60, 230
Animal breeding, experiments and general investigations 60–61, 246
studies by experiment stations 134
dips and disinfectants, investigations 236–237
feeding, studies by experiment stations 60–61, 134
husbandry office, work, 1909 244–249
Industry, Bureau, employees, interference with work, prosecutions 781
estimates and appropriations for 1910 ..... 560, 562
Experiment Station, Bethesda, Md., work, 1909 240–243
growth of force, 1885–1909, officers, 1909 ..... 795, 805
meat and milk inspection, relation to public health, studies 50–51
publications 1909, new and reprints 208, 619–623
report of Chief, 1909 195–259
review of work by Secretary 50–63
studies of diseases of man and animals 50–52
suppression of foot-and-mouth disease 51
nutrition, experiments at State College, Pennsylvania 60–61
investigations 248
products, 1909, value 11
Animals, autopsies, National Zoological Park 224
domestic, contagious diseases, suppression 43, 776
studies of tuberculin serums 60
export, inspection 53, 215

Page.
Animals, grazing in National Forests, receipts for permits, etc. 91–92, 380, 392
  imported, inspection and quarantine, 1909 53, 216–217
  inspection, number and kind 199, 209–210, 213, 214–217
  meat, condemnation, number and kind 199, 209–210
  protection, National Forests 394–396
  rare, importations, 1909, number and variety 543
  slaughtered for foot-and-mouth disease, and appraised value 197, 215
  small, use in pharmacological studies 438
  wild, control, National Forests, 1909 395
    geographic distribution, remarks 121
Ant, Argentine, influence in sugar-cane industry, control studies 530
Antelope, killing, note 125
  protection, efforts to secure 546
Anthracnose, study of life history 271
Anthrax, control, advice to Southern planters 229
  outbreak, South Dakota, 1909 219
  studies 60
Antipyrin, harmful effects, investigations 434–435, 437
  injurious effects, investigation, Bureau of Chemistry 101
Antitoxins, contaminated, necessity of legislation for control 55
Aphids, wheat. *See* Green bug.
Apiary inspection laws, several States, enactments and needs 526
Appalachian region, reconnoissance surveys, 1909 474
Apple diseases, spraying control, demonstration 270
  spraying, cooperative demonstration work 511
    note 72
Apple-leaf diseases, increase in severity 269
Apples, early, adaptability, studies 351
  russeting, result of spraying, control, experiments 270
Appointment Clerk, report, 1909 791–813
Appointments, employees of Department, 1909 791–792
Appropriation, increase for seed distribution 369
  Plant Industry Bureau 261
Appropriations, Agriculture Department, 1909, 1910, and classification 554, 555–556, 561–566
  Department, with dates of acts authorizing same, 1839–1909 567–590
  State, for teaching agriculture 135
Aquatic plants, use in stocking waterways for ducks 121
Argas miniatus, injury to poultry 521
Arid regions, dry-land studies 316–318
  resources, study and publications by Experiment Stations Office 143
  See also Dry-land.
Arizona, alfalfa growing, experiments in propagation 278
  date gardens, study 275
  irrigation projects 65
  range investigations, cooperative experiments 336–337
Arkansas, cattle tick, eradication 55–56
  cotton varieties, selection 305
Arlington Experimental Farm, work, studies and experiments 80–82, 340–342
Arnold, Jos. A., report as Chief of Publications Division, 1909 591–654
Arsenic, accumulation in soils after spraying, plant injuries, etc 512
  in fabrics, wall papers, etc., study in Chemistry Bureau 468
  poisoning of vegetation from smelter fumes 229
Artemisia frigida, perfumery-producing plant of Great Plains 281–282
Asparagus beetles, parasite, discovery 516
  rust-resistant, experiments in breeding 314
Asafœtida, adulteration 430
Atlas, forest, compilation, 1909 390
Automobiles, road injury, prevention, studies 712
Autopsies, animals in National Zoological Park 224

Bacilli, tubercle, studies of duration of life in butter and cheese 59
Bacillus necrophorus, cause of necrobacillosis of sheep 225
Bacteria, cream, ripening, study 253
  nodule-forming, distribution and study 273
  relation to blueberry soil 82
  soil, relation to fertility, studies by experiment stations 134

Page.
Bacterial preparations, failure in rat extermination 117
Bacteriemia, tuberculous in form, studies and experiments 59
Bacterio-chemical investigations, food and drugs, work 421–422
Bacteriology, soil, study and work, etc 73, 272–274
Balloons, use in upper air observations 46, 156, 157–158
Bamboo, Chilean, promising frost-resistant variety 360
    experimental grove, establishment in Florida 359–360
    Japanese, cooperative experiments in propagation in California 359–360
Barium, presence and distribution in soils, study in Soils Bureau 490
Barkbeetles, depredations, National Forests, and control work, 1909 506–509
Barley, American, study of grades 70–71
    beardless, experiments in development 299
    crop, 1909, value and yield, comparison with previous years 12
    cropping systems in dry-land farming, studies 64
    investigations in Europe 360
    seed distribution, varieties, and tests 298–299
    smuts, studies 298
    Tennessee Winter, development in Tennessee 299
    winter, study 70–71
    young, value as green manure 418
Barleys, malting value, study and publication 419
Barnett, Claribel R., report as Librarian, 1909 669–682
Barns, dairy, study of construction 61
Bean, horse, use in California 368
    Japanese, value as leguminous crop in Florida 69–70
    Lyon, value as leguminous crop in Florida 69–70
    soy. *See* Soy bean.
    velvet, importance as leguminous crop for Florida 69–70
Beans, pod-spot, control, study 268
    velvet, varieties, cooperative studies 367
Bee culture. *See* Beekeeping.
    diseases, control, investigations, Bureau of Entomology 115, 525–526
    keeping, Porto Rico, advantages 141
        studies and work, Bureau of Entomology, 1909 115, 525–528
    organic structure and development, studies 527
Beef cattle, unchanged prices 25
    cured, wholesale prices, comparative 27–28
    exports, decline, causes 26
        1851–1909, statistics 19, 20
    prices, increase of retail over wholesale prices in fifty cities 16–17
        movement 24–28
        special investigations, results 15–18
    production, experiments in the South 60–61
    retail prices, comparative 28
    wholesale prices, methods of investigation, results 26–28
Bees, activity, investigation 527
Beeswax, adulteration, and adulterants 436
    analysis, cooperative studies, Bureau of Chemistry and Entomology 436
    prices of various qualities 436
Beet, sugar, by-products, utilization 77
    crop rotation in growing 76
    diseases and their study 77
    investigations and experiments 307–308
    review of work by Secretary 76–77
    seed, experiments in improvement 77, 308
        See also Sugar, beet.
Beetle, Black Hills, control work and practical results 109–110, 507–508
    mountain pine, control, need 509
Beetles, bark, depredations, National Forests, and control work, 1909 506–509
    powder-post, control, progress of study 509
Beets, sugar, cultural methods, studies 308
    diseases and causes 307–308
    experiments with fertilizers 308
    growing, extension 308
Bengalees, Japanese, entry refused 542
Bennett, J. B., report as Appointment Clerk, 1909 791–813

Page.
Benzoate, sodium, report of Referee Board 37
Benzoic acid determination, studies 452, 460
Bethesda Experiment Station, work, 1909 240–243
Beverages, nonintoxicating, medicated, examination 435
Binder twine, hemp, note 78
Binders, road, experimental work 148
Binding, cost for different styles 603
  expenditures, 1909, by Bureaus and classes of publications 601–602
  styles, restrictive order of the Secretary 602–603
Biological Survey, Bureau, aid offered for rodent extermination 119
    educational work 116
    estimates and appropriations for 1910 561, 563
    growth of force, officers, 1909 799–809
    publications, 1909, new and reprints 623–625
    report of Chief, 1909 533–551
    review of work by Secretary 115–125
Birch oil, adulterant of wintergreen oil, detection 432
Bird protection, new legislation 123
  reservations, list, with date of establishment 544
    remarks 123
  reserves, trespass 774
Birds, cage, importations, 1909 543
  California, relation to fruit industry 539, 550
  destruction of green bugs 540
  foreign, importation 542–543
  game, scarcity 116
  importation, remarks 123
  injurious, refused entry 542
  millinery, use, note 122
  North America, migration study 542
  protection, remarks by Secretary 122–125
  relation to boll weevil, investigations 538, 542
    fruit raising 121
  sea, life history studies 124, 544
  shore, food study, destruction of mosquito 540
  study, importance of work 115
Bison range, Montana, establishment and fencing 544
  National, note 124
Black Hills beetle, control, work and practical results, Bureau of Entomology 507–508
Black Vornesh millet, best variety 295
Blackleg, cattle, prevention, experiments 59
  investigations, and vaccine distribution, 1909 232
Black-rot, grape, prevention by spraying 271
"Blast," rice, control, experiments 297
  investigation, note 266
Blight, blade, oats, experiments 298
  twig, white pine, studies 505
  white pine, study 272
  See also Pear-blight; White-pine blight.
Blueberry, acidity in peat, study 419
  domestication, need of acid soil 82
  swamp, experiments in domestication 289–290
Board, Referee, consulting scientific experts, duties and personnel 37–38
Bob veal, sale, prosecution 222
Boll weevil, cotton, insect enemies, introduction, experiments 109
      utilization 501, 502
    Mexican, work of Entomology Bureau 500–503
    work of Bureau of Entomology 108–109
Bonds, examination by Solicitor 786
Bookkeeping, farm, studies 334
Books loaned by Library during year 132
Bordeaux mixture, spraying, injury to apples, studies 270
    use in control of sugar-beet leaf-spot 308
Boric acid, use as preservative, reference to courts 40

Page.
Boston laboratory, food and drug inspection, work, 1909 452–453
Bounties, wolf and coyote, fraud, key for identification of animals 536
Bovinine, experimental feeding 438
Boys' agricultural clubs, cooperative promotion 688
    and girls' agricultural clubs, membership 136
    corn clubs, organization in Michigan 687–688
        work in the South 89
Brakes, hemp, use of machinery 77
Breeding, animal, experiments and results, 1909 60–61, 244–246
        studies by experiment stations 134
    animals, decrease, causes 22–23
    asparagus, rust-resistant, variety selection and studies 314
    birds, reservations set apart 123
    citrus fruits 276
    corn, results 299–301
    cotton, cooperative demonstration 314–315
        studies and results 301, 303–306
    farm crops 294–299
    figs, work 274
    fruits 274–277
    nuts 274–277
    plant, cooperative demonstrations 314–315
    plants, alkali and drought-resistant 319–320
        study, experiments and results 306–307, 313–316
    tobacco, experiments and results 309–313
Brown-rot, bacterial, experiments with vegetables and plants 265
        methods for prevention 265
    peach, control, experiments 270
Brown-tail moth, inspection work, Entomology Bureau 523
        introduction on importations from France 114, 523
        parasites, importations and laboratory work 497, 498
        See also Moth.
Brush, destruction by grazing goats, experiment, Forest Service, 1909 396
Bubonic plague, transmission by rats and squirrels 116, 118, 534, 535
Bud-rot, cocoanut, investigation 266
Buffalo laboratory, food and drug inspection work, 1909 453–454
Building, mechanical shop, consolidation of repair work, etc 151
    new, Chemistry Bureau 464
Buildings, new, for Department, expenditures, and balance, June 30, 1909 554
    Observatory, owned and rented by Weather Bureau, cost 186–187
    rented by Department in District of Columbia, purposes, and rental 559–560
Bulbs, Congressional distribution 368–369
    Dutch, study of propagation in America 83, 369
Bulls, pure-bred, advantages of use 61
Bumblebees, introduction and use in the Philippines 108
Bureau, Animal Industry, etc. *See* Animal Industry; Biological Survey; Chemistry; Entomology; Plant Industry; Soils; Statistics; Weather.
Butter, fishy flavor, result of overworking or of acid in cream 62
    flavor, effect of acid in cream 62
    inspection, methods and results 62–63
    investigations, 1909 253
    manufacturing from pasteurized sweet cream 62
    market inspection, 1909 256
    renovated, inspection, 1909 63, 259
    studies of duration of life of tubercle bacilli 59
    trade losses, study of causes and remedy 62

Cabbage, winter storage, decay, study 268
Cactus, insects, control, studies 504
    investigations 335
    See also Prickly pear.
Caffein, pharmacological studies 438
    use in headache mixtures 435, 437
Cage birds, importations, 1909 543
California, alfalfa, Peruvian, experiments 278
    bamboo propagation 359–360

Page.

California, cattle tick, eradication ... 55–56
  date gardens, study ... 275
  English sparrow extermination ... 539
  evaporation studies of Weather Bureau, 1909 ... 174
  fig breeding, experiments with varieties ... 274–275
  fruits, marketing and handling ... 78, 79, 80
  grape, cooperative study of stock selection and grafting ... 350–351
    transportation methods, study ... 348–349
  ground squirrel. *See* Squirrels.
  Humboldt County, experiments in clover-seed production ... 277
  hydrocyanic-acid gas fumigation work ... 518–519
  legumes, experiments ... 367–368
  lemon industry, study ... 282, 348
  oil production from white sage ... 282
  orange handling, study ... 348
  orchard diseases, studies ... 271
  pear blight eradication, studies ... 269
    thrips, control, investigations and experiments ... 509–510
  plant-introduction garden, work ... 362–363
  rice growing experiments ... 71
  road work, cooperative, in National Forests, 1909 ... 397
  wheat growing experiments ... 295, 417
  wheats, study ... 70
Calorimeter, respiration, studies, and proposed work ... 142, 708–709
    use in nutrition investigations ... 708–709
Calosoma sycophanta, enemy of brown-tail moth, laboratory control ... 497, 498
Calves, immature, sale, prosecution ... 222
  inspection for interstate shipment, numbers ... 22
Camellias, Japanese, infestation with scale insects ... 523
Camembert cheese manufacture, investigations ... 256
Camphor growing, proposed experiments ... 284
  industry, remarks on outlook ... 74
  monobromated, use in headache mixtures ... 435
  seedlings, experiments in growing in Florida ... 281
  trees, experiments in growing in Texas ... 281
Canal Commission, Isthmian, cooperation with Department ... 269
    supplies, examination ... 453
  Zone, agricultural conditions, and work ... 263
    fruit culture, study of possibilities ... 263
    Mangosteen, experiments ... 361
Canaries, importations, 1909 ... 543
Cancer cures, examination, results ... 433
Cane, sugar, insects, proposed work ... 530
    See also Sugar, cane.
  tops, silage experiments, Porto Rico ... 141
Cannabis indica, experiments in growing ... 280
Canning investigations, Chemistry Bureau ... 425
Cans, tin, use of lead solder, investigation ... 456
Carbon tetrachlorid, standard, investigations ... 431
Caribou, killing in Alaska ... 124
Carnegie Institution, bird study and publication ... 124
Carriage horses, American, classification ... 245
Cascara sagrada, destructive methods of obtaining bark ... 280
    growing in Virginia, experiments ... 280
Cassava, new strains for use on Gulf coast ... 86
  seed, pure, reproduction studies ... 333
Cassia, oil, adulteration ... 432
Cattle, beef, export, price movements ... 25
  breeding experiments, Minnesota ... 245–246
  dysentery, chronic bacterial, studies ... 59–60
  exports, 1909 ... 20
  farm prices, movement ... 24–26
  feed, chemical investigations ... 439, 441, 446
  Galloway, experiments in wintering in Alaska ... 139
  grazing, National Forests, and average number in herds, 1909 ... 92, 392
  higher prices, result of tick eradication ... 56
  Holstein, breeding in Minnesota, experiments ... 60–61

Page.
Cattle, infectious ophthalmia, investigations 220–221
  inspection, number for interstate shipment 22
  mange, coal-tar dips, experiments 239
  marketings, diminished, cause of high prices 22
  ophthalmia, infectious, studies 60
  Porto Rico, tick infection 220
  scabies, control work, 1900–1909 213
    eradication, 1909 56
  Southern, breeding in Minnesota, experiments 60–61
  telangiectasis of liver, post-mortem appearance 222–223
  tick, Texas, experimental work, 1909 520–521
  ticks, eradication work, 1909 201–202, 212
  tuberculosis, eradication, methods suggested 57
    experiments of Animal Industry Bureau 56–57
    immunization 59
    investigations 202–204, 229
Ceara trees, rubber production, Hawaii experiments 140
Celery, disease-resistant varieties, studies 343–344
Census Bureau, forest statistics, cooperative work 402
Censuses, agricultural, quinquennial, legal provision for 666
Cercospora beticola, sugar-beet disease, control experiments 308
Cereal insects, investigations 513, 515
  work, Alaska, Rampart Station 138
    proposed investigations 299
Cereal-disease work, studies and experiments 297–298
Cereals, Chinese, selection for arid regions 69
  composition, influence of environment, studies 417–418
  dry-land, experiments in selection of varieties 67
  production and value, 1909, increase over five-year average 13
Chain cultivator, use in boll-weevil control 501–502
Charcoal, manufacture from pine waste 407
Charts, ocean, description, number of copies 595
  work of Weather Bureau, 1909 177–178
Cheddar cheese, work, Wisconsin Experiment Station, 1909 255
Cheese, Camembert, difficulties of manufacturing, and remedies 62
  domestic, interstate samples, examination by Chemistry Bureau 428
  investigations, 1909 255–256
  skim-milk, branding 39
  soft, investigations 256
  studies of duration of life of tubercle bacilli 59
    types and values 62
    remarks 62
Chemical investigations, miscellaneous work, 1909 439–447
  reagents, examination 431
Chemist, report, 1909 415–471
Chemistry Bureau, cooperation with other branches of executive service 115
  estimates and appropriations for 1910 560, 562
  growth of force, 1881–1909, and principal officers 797, 808
  proposed work, 1910, 1911 465–471
  publications, 1909, new and reprints 464, 625–627
  report of Chief, 1909 415–417
  work, review by Secretary 99–102
Chestnut bark, disease, investigation 73, 271
Chicago laboratory, food and drug inspection work, 1909 454–455
  milk supply, examination, character 427
Chickens, cold-storage, handling, proposed investigations 427
    studies, Bureau of Chemistry 102
  See also Poultry.
China, agriculture, study and report 359
  wild peach, studies in grafting with fruit in arid regions 68
  wood oil, importations, uses and value 360–361
Chloris gayana, promising new grass 365
Chokecherry leaves, poisonous to live stock 395
Cholera, hog, investigations, 1909 235–236
  serum, studies in manufacture and use 57–58
Chul wheat, growing, experiments in Califorina 295
Chrysanthemum leucanthemum, meadow enemy 364
  wild, crossing experiments, studies 357

Page.
Cincinnati laboratory, food and drug inspection work, 1909 ... 455
milk supply investigation ... 428, 455
Cities, milk supplies, investigations and improvement ... 207, 218, 250, 258
Citral, determination, method used in Denver laboratory ... 456
Citrange, breeding and crossing with orange, experiments ... 276
Citric acid, experiments in treating tobacco ... 313
Citrus fruits, artificial ripening, and mislabeling, investigations ... 449, 465
by-products, California, possibilities, investigations ... 424
hardy types, breeding experiments ... 276
insects injurious, control investigations ... 112–113, 516–519
trifoliata, hardy deciduous fruit ... 276
Civil Service Commission, amendments to manual of examinations ... 815–816
cooperative work of Department ... 693
regulations, amendments by executive orders ... 814–815
governing promotions, etc., in Department of Agriculture ... 811–813
Cleveland, Ohio, milk supply, score ... 258
Climatological Division, reorganization and work, 1909 ... 173–176
reports, description, number of issues ... 595
Climatology publications, new methods, 1909 ... 175–176
Clover bur, use in Southern States ... 322, 324
crimson, use in South Carolina ... 322
Japan, development as farm crop, study ... 324
red, seed gathering for Great Plains, and experiments ... 277
varieties suitable for winter conditions of Great Plains, studies ... 277
shaftal, usefulness for cotton belt of the South, etc., experiments ... 277
varieties causing trifoliosis, note ... 231
Clubs, boys' and girls', agricultural, organization, membership, etc ... 136, 687–688
Coal-tar dips, cattle mange, experiments ... 239
Cocaine, presence in beverages, examination ... 435
Coccidiosis, ducks, transmission from poultry yards ... 541
Cocoa products, adulteration studies, Boston laboratory ... 452
Coconino Forest Experiment Station, Forest Service, work, 1909 ... 389
Codling moth control, experiments ... 111, 511
parasites, work, 1909 ... 499
Coffee, adulteration with lead chromate, prosecution ... 39
improvement, Porto Rico, experiments ... 140
Cold-storage evaporimeter, patented by Department ... 247
poultry, investigations and proposed work ... 102, 427
Colleges, agricultural, extension work ... 136–138
progress, and State appropriations ... 135
Colocynth, adulteration ... 430
Color, analysis work, New York Laboratory, 1909 ... 459
artificial, use in bakers' products ... 452
Colorado, Black Hills beetle, depredations and control, 1909 ... 507–508
dry-land agriculture, methods ... 64
horse breeding experiments, 1909 ... 60–61, 244
scabies, eradication, 1909 ... 56
Commerce and Labor, Department, cooperation of Forest Service ... 99
Secretary, authority to make regulations for enforcement of Food and Drugs Act ... 36, 38
Confectionery, adulterations, prosecution ... 39
Congress, acts authorizing appropriations, Agricultural Department, 1839–1909 ... 567–590
Members' quotas of Farmers' Bulletins, etc ... 129
Congressional publications, Department of Agriculture, 1909 ... 614–616
seed distribution ... 83, 368, 369
Conium, adulteration practices ... 430
Connecticut, gipsy moth, work, 1909 ... 494
tobacco investigations ... 311
white pine disease, study ... 272
Contagious diseases, domestic animals, suppression ... 43, 776
Contract supplies, examination by Chemistry Bureau ... 444–445
Contracts and leases for 1909, preparation and examination ... 44
Laboratory, proposed work ... 469
preparation of papers, scope, etc ... 784–786
Cooperation, cotton breeding work ... 278–279
dry-land agricultural investigations ... 317–318

Page.
Cooperation, forest insect control 505–509
fruit marketing 347
Cooperative work, Forest Service 99
Copper sulphate, use in foods, reference to Referee Board 38
Corn, acclimation and adaptation, investigations and experiments 301–302
breeding, investigations and results 299–301
new place, effect 306–307
broad breeding, experiments and value 302
clubs, boys', organization in Michigan 687–688
work in the South 89
composite breeding, results 302
crop, 1909, value and yield, increase over previous years 10
cropping systems, dry-land farming 64
crossing experiments, increased yield 302
cultural methods, studies 299–301
culture, Williamson method, study 300
demand for cattle feed, effect on price 21–22
drought-resistant varieties, selection 301
earworm, injury to tomatoes, control 516
experiment station studies in growing and breeding 71
experiments in breeding in the South 71
farms, middle West, replanning for profit, study 87
fertilizers, use 300
growing, methods in the South 71
improved condition owing to greater care 294
insects, investigations 515
irrigated sections, experiments 300–301
variety selection, experiments 301
price, relation to price of hogs 29
production, improvement and results 301
relation to pellagra, note 75
seed, experiments in production 71
sweet, cooperative studies of climatic and soil conditions 345
environment studies 416
studies by Bureau of Chemistry 99–100
sugar content, studies 416
use of moisture-testing apparatus, and results 294
varieites, adaptive characters 300, 302
Cornstalks, paper making experiments 84, 406
Correspondents, Statistics Bureau, work in crop reporting 131
Corrosion, iron and steel, laboratory studies, Roads Office 737–738
Cotton, acclimation, experiments 303–306
Arkansas, selection of varieties 305
baling, studies 286
boll weevil. *See* Boll weevil.
breeding, cooperative demonstrations 314–315
experiments 303–306
in Texas 305–306
new place, effect 306–307
South Carolina, selection of varieties 305
variety selection and studies 314–315
crop, 1909, value, increase over other years 10–11
disease-resistant varieties 267–268
diseases, control, study 72, 267–268
Egyptian, growing in Southwest, progress 278, 304, 319
growing, experiments in Hawaii, varieties and methods 139–140, 696–697
fertilizer experiments 316
"Hindi," origin and studies 304
hybrids, deterioration, study 304
study of characters 305
perennial, experimental growing, Hawaii 139
root-knot. *See* Root-knot, cotton.
selection of varieties 303, 305
stalks, paper making experiments 406
standardization, establishment of grades, etc 84, 263–264, 285–286
varieties, new, experiments 303
weevil-resistant, new types 303

Page.
Cottons, Mexican big-boll, promising new upland types 303
Cotton-seed meal, injury to live stock, investigations 223
Court decisions, violations of twenty-eight hour law 760–773
    of Claims, cases against United States 775
Covers, game, stocking, experiments 543, 547
Cowpeas, hybrids, crossing experiments 356
        increase of cultivation in Alabama 324
        seed saving, improved method with machinery 86
Cows, dairy, Southern, experiments 61
    tuberculous, experiments in testing 57
            transmission of disease to hogs 241–242
Cow-test association work and results 206, 251
Coyote-proof pastures, experiments and results 288
Cranberry insects, control by spraying, experiments 110, 510, 511
Cream, acidity, effect on keeping quality of butter 62
    pasteurized, butter-making experiments 253
    sweet, pasteurized, method of butter making 62
Creameries, investigations, official, results and benefits 62–63
        skim milk, transmission of disease 241–242
Creamery buildings, plans and blueprints, work of Dairy Division 257
        investigations, 1909 256–257
        sewage-disposal system, study, Dairy Division 252
Creosote, use in destruction of gipsy-moth egg clusters 493
        wood preservation, amount used, 1909 402, 404
Cresolis compositus, liquor, use in destruction of hog-cholera virus 236
Crop acreage, revision of estimates 665
    adaptation, effect of economic conditions, note 64
    breeding, investigations 274
    conditions, investigations, value to commerce 130
    physiology, investigations 274
    production, effect of economic conditions, note 64
    Reporting Board, personnel 661–662
            service, organization and methods 130–131
    reports, collection and handling, Statistics Bureau 130–132
            contents and time of issuance 662–664
Cropping systems for stock farms, study 332–333
Crops, chemical composition, effect of environment, studies 416–419
    chief, production, value, etc., 1909 10–14
    destruction by rodents, notes 118, 119
    drought-resistant, experiments in dry-land sections 65–66
    failure, studies of semiarid conditions 68
    farm, cost of production, study 87
    forage, Chinese, selection for arid regions 69
    handling and grading, work, note 285
    leguminous, study for Southern States 69–70
Crown-gall, study of plant diseases 266
Cultivator, chain, use in boll-weevil control 501–502
Curing meats, investigations 234
    tobacco, new method of using heat 75
Cytodites nudus, cause of intestinal diseases in poultry 224

Dahlias, new hybrids, distribution 357
Dairy buildings, drawings, work of Dairy Division 252
            study of construction in the South 61, 250
    Division, work, 1909 206–207, 249–259
    farming investigations 249–252
    farms, management, and system, study 332
    herds, studies in the South 61
    manufactures, work, 1909 256–257
    products, analysis and examination 62, 427–428
    schools in South, conduct and results 250
    score cards, use, results on city milk supplies 250, 258
Dairying, South, study of possibilities, and results 61–62
            work of Animal Industry Bureau, 1909 61–62, 207, 249–251
Daisy, oxeye, weed enemy of meadows 364
Damping-off disease, coniferous seedlings, studies 272

Page.
Date, Chinese, grafting experiments in the South 69
  drought-resisting qualities, studies 68
  growing, southwestern United States 275–276
  palm, varieties, investigation 275–276
Deaths, Department employees, 1909, names and other data 45, 792–793
Deer, killing, notes 125
  statistics, collection 546
Delegates in Congress, quotas of Farmers' Bulletins, disposal 129
Demonstration farms, work and plans 337–338, 339, 506–507
Denver laboratory, food and drug inspection work, 1909 455–456
Department of Agriculture. *See* Agriculture, Department.
Dermatitis necrotis, sheep (necro-bacillosis), outbreak and treatment 225
Detroit laboratory, food and drug inspection work, 1909 456
Diaries, field, traveling employees 151
Diaspis pentagona, shipments to Italy and Peru 499, 500
Dietaries, change, cause of decline in meat consumption 20
Dionin, use in so-called addiction cures 435–436, 437
Dippings, scabies, sheep, cattle, and horses 213–214
Dips, animal, investigations 236–237
  arsenical, cattle ticks, experiments 239–240
  coal-tar, use for cattle mange, experiments 239
Dipterous parasites, importation and testing 498
Director, Experiment Stations Office. *See* Experiment Stations, Director.
Disbursements, Department, 1839–1909, details 567–590
    Division. *See* Accounts.
Disease, insects carrying, work of Bureau of Entomology 113, 519–521
Diseases, animal, causes of condemnation of meats 210
    National Forests, protection 394
  animals of Zoological Park 224
    studies by Animal Industry Bureau 50–52
  bacterial, sweet corn, experiments 266
  bee, control, investigations 525–526
  cereal, experiments 297–298
  contagious, domestic animals, suppression 43
  forest and ornamental trees and shrubs, studies 271–272
  fruit, investigations 269–271
  man, studies by Animal Industry Bureau 50–52
  orchard, studies 271
  plant, lines of study 72
  sugar beets, causes and control methods 307–308
  tobacco, Florida and Georgia 312
  wild ducks, transmission from poultry yards 541
Disinfectants, animal, investigations 236–237
    hog cholera, experiments and results 235–236
Distillation, denatured alcohol, experiments by Bureau of Chemistry 102
    wood turpentine, studies by Bureau of Chemistry 102
Distillery, alcohol, experimental, use is educational course, Chemistry Bureau. 415
District of Columbia. rabies, cases diagnosed by Animal Industry Bureau 226–228
Ditch borers, rodents, control 536–537, 549
Division, Accounts; Publications. *See* Accounts; Publications.
Documents, Superintendent, authority to reprint and sell publications 599
    See also Publications.
Dogs, experimental feeding, pharmacological studies 438
  muzzling recommendation as preventive against rabies 58
Dorset, M., method of preparation of hog cholera serum 57–58
Drag, split-log, use in road maintenance 714–715
Drainage, humid regions, studies 147
  information, dissemination, 1909 707
  investigations, Experiment Stations Office 145–147, 705–707
  irrigated land, cost per acre 147
    lands, important problems 145–147
      methods 146
      proposed work, 1910, 1911 707–708
  work, 1909, review 705–707
Drinks, "soft," medicated, examination 435
Drug addiction, cures and dangers, investigations 435–436

Page.
Drug adulteration 450
  Inspection Laboratory, work, 1909 450–451
      work, Chemistry Bureau 447–464
  legislation, United States, general remarks 436
  plants, investigations, discussion 74, 279–281
    testing, proposed investigations in the Southwest 284
    work in Florida and Texas 280–281
  products, synthetic, investigations 437
  samples, examination in branch laboratories, 1909 451
  work, Chemistry Bureau, 1909 429–439
Drug-habit, "cures," investigations 435–436
Drugs, adulteration, inspection work of Bureau of Chemistry 100–101
  and Food Act, enforcement by Department 34–42
      violations, convictions and fines 41
  Chinese, study at San Francisco laboratory, difficulties 462
  crude, importations, improvement under inspection 40
  habit-forming, cures and dangers, investigations 435–436
  imported, adulteration, lessening of practice 430
    control work 40
    examination 450, 458, 459
Dry-farming, cooperative experiments, stations 296–297
  Great Plains, experiments and results 296–297
  work of Plant Industry Bureau 64–68
Dry-land crops, continuation of experiments in Southwest and West 297
  fruits, cooperative experiments in Colorado 351
Ducking grounds, investigations 548
Ducks, food, study and suggestions 121
  wild, disease, coccidiosis 541
    food investigations 541
Durum wheat, export 295
  production, 1909, and extension 295
  supply and demand 295
    See also Wheat.
Dust preventives, experimental work 148
Dutch bulbs, home production, note 83
Dysentery, chronic bacterial, in cattle, studies 59–60
    introduction from Island of Jersey 221

Ear tick, spinose, investigations 521
Earworm, corn, tomato injury, control 516
Easter lily bulb industry, establishment in United States 356
Editor, report, 1909 591–654
Editorial work, amount and character, 1909 603–605
Education, course in experimental distilling of denatured alcohol 415
  dairy schools, conduct and results 250
  forestry, courses, Western States 381
  need, in regard to birds and mammals 116
  veterinary, standards and requirements of civil-service examination 204–205
Eggs, adulteration, investigations 449, 465
  analysis, study and investigations, and proposed work 425–426, 445, 469, 470
  dried, investigations, 1909, and proposed work 445, 469
  marketing, study of conditions 61
  production, study of conditions 61
Egyptian cotton, hybridization, growing in Southwest, etc 278, 304, 319
Elk, Roosevelt, reservation establishment 124, 545
Elm leaf-beetle, parasite, efforts to secure 499
Emmer, black winter, adaptation to Central and Eastern States 295
Employees, Agriculture Department, changes, 1909 45
  appointments, promotions, removals, etc 791–793
  impersonation, case 781–782
  interference in duties, cases, disposal, etc 781
Emulsion, oil, with tobacco extract, pear thrips control 509
Engineering, highway, instruction in Public Roads Office 150
English sparrow, extermination work in California 539
Enological-chemical studies 420–421
Enteritis, poultry, causes 224
Entomologist, report, 1909 491–531

Page.
Entomology Bureau, cooperation of Chemistry Bureau in studies of beeswax... 115
    with executive departments, studies... 340
  estimates and appropriations for 1910... 561, 563
  growth of force, 1881–1909, classification of employees, principal officers... 799, 809
  proposed work, 1910, 1911... 529, 531
  publications, 1909, new and reprints... 627–630
  work, review by Secretary... 107–115
 forest, cooperative work and results... 505–509
Entries, forest lands, patents issued by Department of Interior... 97
Enzyms, study, Chemistry Bureau... 420
Epizootic lymphangitis, horses, studies... 59–60
Erigeron spp., enemy of meadows... 364
Estimates of appropriations, Agriculture Department, for 1910... 560–561
Ethyl acetate, standard, investigations... 431
Eucalypts, south Texas, study by Forest Service... 400
Eupatarium ageratoides, connection with milksickness, investigations... 283
Europe, barley growing investigations... 360
 forest administration, cost per acre... 95
Eutettix tenella, insect enemy of sugar beet, control methods... 307–308
Evaporation observations, apparatus, improved forms... 172
 studies, Salton Sea and other stations... 49–50
  Weather Bureau, 1909... 174
 study, new instruments... 50
Evaporimeter, cold storage, device for determination of moisture... 61
  patented by Department... 247
Ewes, pregnant, paralysis, symptoms and control... 221
Examinations, civil-service, amendments to manual... 815–816
Executive orders, civil-service regulations... 814–815
Expenditures, Agriculture Department, 1909, and classified statement... 554, 555–556, 565–566
 Forest Service, classification and amount, 1909... 371–372
 Plant Industry Bureau, 1909... 261
Experiment Station Record, scope of work... 134
 stations, and agricultural colleges, cooperation with department... 133 686–688
  Director, educational work... 136
  distribution in Great Plains area... 316–317, 318
  insular, review of work by Secretary... 138–141
   work, 1909... 693–701
  lines of work, brief references... 134
  Office, cooperation in educational work... 686–688
   estimates and appropriations for 1910... 561, 563
   exhibits at Alaska-Yukon-Pacific Exposition... 693, 696, 698
   growth of force, 1889–1909, classification of employees, principal officers... 801, 802, 810
   publications, methods... 685, 690–693
    1909, new and reprints... 631–637
   relations with agricultural experiment stations. 683–685
   report of Chief, 1909... 683–709
   review of work... 133–147
Experimental farm, Arlington, investigations and experiments... 340–342
Exports, agricultural, 1909, value, comparison with previous years, etc... 14–15
 forest products, 1909, value... 15
 meat, statistics, 1851–1909... 19–20
Exposition, Alaska-Yukon-Pacific, exhibits from various bureaus... 149, 173, 409, 693, 696, 698, 714
Extension work, agricultural colleges... 136–138
Extracts, flavoring, detection of adulteration, and other investigations... 424

Fairs, danger of spread of tuberculosis... 203
Farm bookkeeping, data... 334
 crops, cost of production, study... 87
 economics, studies... 333–335
 equipment, experiments... 334–335

Page.
Farm management, cooperative demonstration work in South Carolina.... 322–323
  review of work by Secretary.... 86–88
  work, Plant Industry Bureau.... 321–330
 organization, economic, cooperative studies, data.... 333–334
 plans, studies, data.... 335
 practice investigations.... 330–333
 products, advantages of increased value.... 10
  cost of production, cooperative investigations.... 665
  increase in prices, comparison with other commodities.... 31–34
  value, in 1909, increase over previous years, etc.... 9–10
   summary of comparisons.... 13–14
  wholesale prices 1896–1900, comparison with other commodities by Secretary.... 33–34
  See also Agricultural products.
Farmer, share in increased price of beef, remarks by Secretary.... 24–26
Farmers' Bulletins, distribution, extent and increase.... 128–129
  history, object, growth of demand, copies issued.... 595–597
  issued 1909, classified by Bureaus and by subjects.... 592, 597
  mailing, work of 1909.... 608
  output and cost, 1907, 1908, 1909, comparison.... 597–598
  undistributed quotas, change in disposal, discussion by Secretary.... 129
 cooperation, farm management demonstration work.... 322–323, 688–690
 cooperative demonstration work, development and extension. 88–89, 337, 340
   plans and organization.... 337–340
 Institutes for women, organization and work.... 138
  review of work.... 136–138, 688–690
Farming, dry-land, studies of cropping systems.... 64
 successful, dependence upon soil adaptation to crops.... 106
Farms, abandoned, problem of resettlement, discussion by Secretary.... 106–107
 demonstration, semiarid region.... 144
 increase in value as cause of increase in price of meat.... 22
Feces, tuberculous, source of tuberculosis in hogs.... 59
Feed, cattle, chemical investigations.... 439, 441, 446
Feeding, animal, studies by experiment stations.... 134
 animals, experiments and results, remarks by Secretary.... 60–61
 stuffs, weed seed distribution and studies in experiment stations.... 134
Fencing, steel-wire, corrosion, laboratory studies, Public Roads Office.... 737–738
Fern, male, use as medicine, note.... 239
Fertility, soil, inexhaustible under certain conditions.... 105
  investigations, 1909.... 485, 488
  studies, United States and foreign countries, review by Secretary.... 104–106
Fertilizer, reduction of cost in Southern States.... 338
 use in corn culture, and method.... 300
Fertilizers, action upon organic matter in soils.... 486
 commercial, use in tobacco growing, and results.... 311–312
 cotton nutrition, experiments.... 316
 farm use, studies.... 332
 orchard, in Virginia, study.... 270–271
 plant-nutrition studies.... 81
 Southern corn growing, experiments.... 71
 sugar beet growing, experiments.... 308
 tobacco, discussion by Secretary.... 76
  experiments.... 310
Festuca viridula, useful plant for reseeding overgrazed range lands.... 288–289
Fever, swamp, among horses, studies.... 59–60, 230
Fiber investigations, remarks.... 286–287
  review by Secretary.... 77–78
 See also Cotton; Flax; Hemp.
Fibers, new uses for hemp and flax, notes.... 77, 78
Field diaries of traveling employees.... 151
 mice. *See* Mice, field.
Fig breeding and culture.... 274
 caprifying insects, introduction and results.... 274
 orchards, California.... 274
Figs, importations, requirements, and improvement in packing methods.... 38–39

Page.
Figs, Smyrna, culture, study 274
Fire control, National Forests, cost 383, 384
  lines, value, demonstration 397, 398
  losses in National Forest, 1909 .... 91, 96, 99
  trespass cases, litigation, 1909 .... 378, 387
Fires, forest, destructive to forests 398
    losses in 1908 96
    protection in National Forests 91, 96, 99
Fiscal affairs, inspection by Chief of Accounts 566
      See also Accounts.
Flavors, butter, study 253
Flax breeding, proposed experiments for 1910 287
  growing for fiber and seed, remarks 78
  straw, paper making experiments 406
Flax-pulling machine, note on introduction 78
Flaxseed, production and yield, 1909, comparison with previous years 12
Flea beetle, tobacco, control 503
Flood and River Service, work, 1909 .... 48–49, 170–171
Floods, 1909, amount of damage 48
   various States, extent and losses, 1909 170
Florida, beans as leguminous crop, study 69–70
   cooperative experiments with Algerian and Spanish geraniums 281
   establishment of bamboo experimental grove 359–360
   forest conditions, cooperative work, 1909 399
   Key West hurricane, October 11, 1909, work of Weather Bureau, notes and comments 165–170
   Miami, subtropical garden work 370
   orange industry, study 348
   oranges, marketing and handling, review by Secretary 79
   tobacco, work and experiments 312
   truck crop insects, investigations 515
Flour, bleached, decision and reference to the courts 36, 41
  durum wheat, manufacture in Minnesota 66
  moth, Mediterranean, control by fumigation 114
  pharmacological studies 438
Flowers, pollination, new method 357
Fly, house, control, work, 1909 .... 113, 520
  white. *See* White fly.
Flycatchers, beneficial habits, investigations 540
Fog chart work of Weather Bureau 178
Food adulteration, definition and discussion 37
  and Drugs Act, constitutionality, question, rulings, etc 741, 743
      enforcement by Department, remarks by Secretary 34–42
      violations, convictions, fines, list and status of cases. 41, 741–759
  Inspection Decisions, 1909 617
     Laboratory, work, 1909 449–450
     work, Chemistry Bureau 447–464
  interstate samples, examination in Chemistry Bureau 446
  muskrat as article on market 120
  nutritive value, studies 142
  protection from rats 534
  samples, examination in branch laboratories, 1909 451
Foods in storage, deterioration, study by Bureau of Chemistry 102
  wholesale prices, 1896–1900, comparison with other commodities by Secretary 33–34
Foot-and-mouth disease, animals slaughtered and value 54
      condemned animals, settlement with owners 53–54
      eradication, amount expended by Department of Agriculture 54
        scope and method 51, 53–55
      outbreak, 1908, origin, remarks by Secretary 54–55
        quarantine methods for eradication .. 53–55
        spread, and control, 1909 .... 196–199, 214–215
        veterinarians in charge 197
Forage crop conditions, studies 368

Page.
Forage crops, drought-resistant, cooperative experiments in Great Plains...... 367
        dry-land sections, studies and results........................ 65, 66
        rotation, studies.. 332–333
    plant insect investigations.................................... 513–515
    prickly pear, use and value.................................... 88
    production, improved methods................................... 86
    yield, National Forests, animals fed, and receipts for permits........... 91–92
Forecasts and warnings, distribution, results, and press notices in various cities,
        1909 .... 158–165, 181–183
    work of Weather Bureau, review by Secretary........................ 45–47
Foreign trade, balance in favor of United States, cause of decrease............ 15
        in agricultural products..................................... 14–15
Forest advisory boards, work in range management........................ 391–392
    Atlas, compiling, work, 1909.................................... 390
    diseases, investigations....................................... 271–272
    entomology, cooperative work and results........................... 505–509
    homestead law, land acreage listed................................ 97
    information, diffusion, methods and cost........................... 407–409
    management, work, 1909.. 383–390
    owners, cooperation of Forest Service.............................. 99
    pathology, study, remarks...................................... 74
    products, foreign trade, 1909, balance against United States, etc........ 15
        inspection for gipsy moth infestation........................ 107, 109
        statistics, cooperative work, Census Bureau.................... 402
    Service, classification of employees and principal officers........ 797, 806–808
        cooperation of States in forestry work........................ 398–400
            with other executive services......... 97, 98, 99, 263, 340
                timber-land associations....................... 96
        cooperative study of fruit growing on forest ranges........... 351–352
        district organization, effects on work........................ 381–382
        estimates and appropriations for 1910.................... 560, 564–565
        exhibit at Alaska-Yukon-Pacific Exposition.................... 409
        growth of force, 1880–1909.................................. 797
        organization changes, new districts, location.................. 95
        publications, 1909, new and reprints.......................... 637–641
        report of Chief, 1909...................................... 371–413
        review of work, and plans for coming year............ 90–99, 409–413
    trees, diseases... 271, 272
    Wallowa National, experiments in reseeding of overgrazed range lands. 288–289
Forester, report, 1909.. 371–413
Forestry, Bureau of. *See* Forest Service.
    educational courses, Western States............................... 381
    interstate relations, discussion.................................. 399
    introduction into schools.. 408
    State cooperation with Forest Service............................. 398–400
Forests, European countries, cost of administration per acre................ 95
    insect injury, protection work, 1909, etc........................... 109, 387
    insects injurious, investigations and results......................... 504–509
    National, area, location, administration, etc........................ 372–397
        as public property... 90
        cost of administration and protection......... 90, 92, 95, 96, 379–380
        executive force.. 380–381
        improvements, cost, description, and cooperative work. 379, 396–397
        names and areas, 1909...................................... 373–374
        protection from fire.. 91, 96, 99
        receipts, 1907, 1908, and 1909............................... 93
            for grazing and timber.......................... 90, 92, 93, 94
        timber stand distribution, sales, receipts and free use...... 92,
            93, 97, 383–388
        water-supply protection 90–91
    private, aid of Entomology Bureau................................. 506
        cooperative work of Forest Service............................ 400
    special uses, receipts, 1909...................................... 379, 380
Fowls, tuberculosis, studies in Oregon.................................. 59
France, Paris, meeting of Road Convention, 1908.......................... 712

Page.
Fretes wheat, growing, experiments in California.... 295
Fruit breeding, cooperative studies in Iowa.... 352–353
    by-products, cooperative studies.... 347
    cooling, effect in shipping.... 79
    diseases, investigation.... 72, 269–271
    drying, experiments.... 285
    garden, dry-land, cooperative work, progress.... 351
    handling, experiments.... 285
    industry, California, relation of birds.... 539, 550
    investigations, Plant Industry Bureau.... 269–271
    marketing, cooperative organization work.... 347
        studies.... 78–80, 346–347
    precooling investigations.... 349
    products, investigations, Chemistry Bureau.... 422–423
    raising, Panama Canal Zone, studies.... 263
        relation of birds.... 121
    storage, experiments.... 285
    transportation and storage, studies.... 349
    varieties, adaptability, studies.... 80, 351
        cooperative investigations and experiments.... 346
        identification, studies.... 346
Fruits, breeding and adaptation, work.... 274–277
    Chinese, selection for arid regions.... 69
    citrus, artificial ripening and mislabeling, investigations.... 449, 465
        hardy types, breeding studies.... 276
        increase of fungous diseases.... 269
        insects, investigations.... 516–519
    deciduous, decrease of fungous diseases.... 269
        insects injurious, Entomology Bureau work, review by Secretary.... 110–119
    drought-resistant, experiments in Arizona, Nevada, and New Mexico.. 278–271
    nomenclature, simplification.... 345–346
    stone, damage from brown-rot, control, experiments.... 270
    tropical, propagation studies, Hawaii.... 139, 697
    varieties for Alaska, experiments.... 696
Fumes, smelter, effects on live stock through poison vegetation.... 229–230
Fumigation, citrus orchards.... 517, 518–519
    control of Mediterranean flour moth.... 522
    flour mills, for control of Mediterranean flour moth.... 114
    hydrocyanic-acid gas, in citrus orchards of California.... 113
    ships, for destruction of rats.... 534
Fungicides, examination by Chemistry Bureau.... 439, 441
    spraying apple trees, varieties, experiments.... 270
    use against fruit diseases.... 72
Furnace slag, road-construction experiments.... 149

GALLOWAY, B. T., report as Chief of Bureau of Plant Industry.... 261–370
Galveston laboratory, food and drug inspection work, 1909.... 456
Game, big, possibilities of growing for market, remarks.... 120
        statistics, collection.... 546
    information, collection and publication.... 124
    interstate commerce in, remarks.... 123
        supervision.... 548–549
    introduction, discussion.... 122–125
    law, violations of Lacey Act, disposal.... 774
    laws enforcement, cooperation of Forest Service.... 43, 378
        violation, testing.... 544
    legislation, index, progress.... 546–547
    officials, directory, publication.... 547
    preservation, discussion.... 122–125
    preserves protection, cooperation of Forest Service.... 396
    protection, Alaska, 1909.... 124, 545
        work, 1909, and proposed work, 1910.... 542–549, 550–551
    refuges, remarks.... 124
    scarcity of birds and mammals, reason.... 116
    statistics, collection.... 545–548

Page.

Garbage, disposal, relation to rat pest ... 118
Garcinia xanthochymus, mangosteen species ... 361
Garden, subtropical, Miami, Fla., cooperative work ... 370
Gardens, Department, changes ... 82
  fruit and ornamental, establishment on forest ranges, cooperative study ... 351–352
  south Texas, cooperative studies and results ... 370
  testing and plant introduction ... 85–86, 370
Geese, wild, increase in numbers, suggestion for providing food plants ... 121
Gelatin, sulphurous acid content, study ... 453
Geographic distribution, birds and mammals, work, 1909 ... 541–542
    wild animals and plants, remarks ... 121
Geological Survey, phosphatic deposits, locating and mapping ... 490
Georgia, horticultural fair, cooperative study of crop breeding ... 315
  paper making, experiments ... 362
  tobacco work and experiments ... 312
  worn-out farm, development and results ... 323
Geraniums, Algerian and Spanish, experiments ... 281–282
Gid, sheep, investigations ... 239
Gipsy moth, parasites, importations and laboratory work ... 495–498
    work, Department and States, 1909 ... 492–495
    See also Moth.
Girls' and boys' agricultural clubs, membership ... 136
Glanders, horses, experiments in diagnosis ... 59
Glucose, work, branch laboratories ... 453, 456
Goats, grazing, National Forests, number, 1909 ... 392
  use in clearing land, experiment, Forest Service, 1909 ... 396
Graduate schools. *See* Schools.
Grafting, fruit, in arid regions, experiments ... 68–69
Grain, commercial, artificially drying, studies ... 293
    carrying capacity and quality, study ... 293
  dry-land, experiments and results ... 296–297
  feed for cattle, investigations ... 439, 441, 446
  handling and grading, work, note ... 285
  Investigations Office, work ... 294–299
  marketing, inspection of cargoes in European ports ... 85
  modification by environment, experiments ... 296
  moisture content, method for determining ... 321
  sorghums, dry-land experiments, continuation ... 297
  standardization work ... 84–85, 292–294
  See also Barley; Corn; Oats; Rye; Wheat.
Grains, storage, chemical changes, study ... 419
  See also Cereals.
Grape, California, resistant stocks and grafting experiments ... 350–351
    transportation methods, study ... 348–349
  diseases, studies ... 271
  industry, studies ... 350–351
  investigations, Pacific coast and South ... 80
  root-worm, control work, Bureau of Entomology ... 111, 512
  Rotundifolia, cooperative studies ... 350
  Scuppernong, unfermented juice, studies ... 422–423
  varieties, disease-resistant, studies ... 351
Grapes, California, marketing ... 79
  varieties for wine making, studies by Bureau of Chemistry ... 100
Grass, damage by prairie dogs ... 119
  mountain bunch, use in reseeding overgrazed range lands ... 288
  Panicum, North American species, studies ... 290
  range, insect injuries, study ... 515
  Rhodes, value as southern crop ... 70
  seed, production studies ... 365
  sorghum, description ... 70
Grasses, improvement studies ... 365
  meadow and pasture, alkali-resistant, studies ... 319
  new, studies of varieties for the South ... 70, 365, 366
  study of varieties and conditions ... 290, 364–365
Grazing, experiments with pastures ... 365
  free, National Forest, 1909 ... 380–392

Page.
Grazing, National Forests, receipts, 1909 .... 379, 380, 392
    permits, National Forests, number and kind, 1909 392–393
        receipts, and number of live stock 91–92
    private lands, exchange of permits with Forest Service 394
    regulations, relation to water supply 91
    State lands, cooperation with Forest Service, 1909 393
    trespass cases, litigation, 1909 378–391
Great Britain, tuberculin test, 1909 217
  Plains area, distribution of Experiment Stations 316–317
        dry-land agriculture, studies 316–318
        irrigation studies 64–68
        moisture conservation studies 64
      black sage, value for perfumery, experiments 281–282
      drought-resistant forage crops, studies 367
      reconnoissance surveys, 1909 474
      wheat growing, experiments 24
Green bug, control, spraying and cultural methods 111, 513–514
      destruction by sparrows 540
      parasites, investigations 513–514
Greenhouse experiments with cereals 419
      work, Arlington Experimental Farm 341
        propagation and distribution of plants 354
Greenhouses, Department, work, changes, construction and repair 82, 354–356
Grimm, alfalfa. *See* Alfalfa, Grimm.
Ground squirrel. *See* Squirrels.
Grounds, Departmental, general improvement 82, 355–356
Guam Experiment Station work 141, 693, 694, 699–701

Habit-forming drugs, investigation of "cures" 434–436, 437
Hairy vetch. *See* Vetch.
Halladay Havana tobacco, experiments in Connecticut and Massachusetts 311
Hansen, N. E., study of new types of forage crops 68
Hawaii agricultural college, establishment, 1909 135
    Experiment Station, work 139, 693, 694, 696–698
Hay crop, 1909, value and yield, comparison with other years 11
  production, curing, handling, and marketing, study 330–331
Headache remedies, dangers, investigation 101, 434–435, 437
Health, public, relation of Animal Industry Bureau, work 50–52
Hemp, breaking by use of machines 77
    growing, experiments, and improvement of retting process 286–287
    Indian, experiments in growing in Virginia 280
    Wisconsin, cultivation and yields 77
Henbane leaves, adulteration 430
Heredity, animal, experiments at Bethesda, Md., experiment station 60–61
Hessian fly, control, late sowing of wheat as means 112, 514
Heterakis papillosa, cause of disease in golden pheasants 224
Highway engineering, instruction, Public Roads Office 150
Highways. *See* Roads.
Hindi cotton, origin and study 304
Hodgkin's disease, hogs, post-mortem appearances 223
Hog cholera, investigations, 1909 235–236
      serum, studies in manufacture and use 57–58
Hogs, carcasses, wholesale prices, comparative 29
  grazing, National Forests, number, 1909 392
  marketing, diminished, effect on prices of pork 22–23
  pseudo-leukemia, post-morten appearances 223
        studies 60
  relation to cropping system, studies 326
  slaughtering, cost, comparative 29
  tuberculosis, eradication, methods suggested 57
        result of feeding on feces of tuberculous cattle 59
        sources of infection 241
        transmission from poultry, investigations 228
  See also Swine.
Holland, nursery-stock inspection, reliability 524
Holstein cattle, breeding experiments 60–61, 246

Page.
Home problems in nutrition, study by Experiment Stations Office 142
Homestead entry, applications and listings, National Forests 375–377
law, Forest, land acreage listed 97
Honeys, imported, investigations 429
Honolulu laboratory, food and drug inspection work, 1909 457
Hop crop, 1909, value and yield 13
growing, proposed experiments 284
Hops, American and German, experiments in crossing 282
breeding experiments on Pacific Coast 74, 282
Hornworm, tobacco, control 503
Horse breeding, work, 1909 244–245
Horses, breeding, Clydesdale, experiments in Iowa 60–61
Morgan, experiments in Vermont 60–61
Shire, experiments in Iowa 60–61
carriage, American, classification 61, 245
breeding, experiments in Colorado 60–61
grazing, National Forests, number, 1909, and size of herds 92, 392
infectious anemia, experiments 230
scabies, control work, 1909 214
swamp fever and epizootic lymphangitis, studies 59–60
Horticultural investigations, Arlington Experimental Farm 342–345
House fly, control, work, 1909 520
HOWARD, L. O., report as Entomologist, 1909 491–531
Humid regions, drainage studies 147
irrigation possibilities, studies 144
Hunting licenses, statistics, collection 548
Hurricane, Key West, Fla., Oct. 11, 1909, work of Weather Bureau, notes and comments 47–48, 165–170
Hybridization, fruit trees, experiments and results 276, 277
plants, work and results 356–357
roses, studies 357
Hybrids, cotton, characters, suppressed and intensified, study 305
zebra-ass, breeding experiments at Bethesda, Md., experiment station 60
Hydrocyanic-acid gas fumigation, citrus orchards, California 113, 517, 518–519
presence in almond extract, prosecution 455
Hydrogen peroxide, adulteration 431
use in necrobacillosis 226
Hygienic work, chemical investigations, scope 439
Hymenopterous parasites, importation and testing 498
Hyoscyamus muticus, substitute for henbane leaves 430
Hyponomenta padella, introduction on seedlings from France 523

Ice cream, studies by experiment stations 134
Idaho, road work, cooperative, in National Forests, 1909 397
soil, water studies 484
Illinois, paper-plant testing, experiments 286
Illustrations, work, 1909 609–610
Importations, foreign mammals and birds 542–543
plant, inspection for insect infestation 114–115
seeds and plants, biweekly bulletin, issue and distribution 358
Imports, agricultural products, 1909, value, increase, etc 14
forest products, 1909, value 15
Inbreeding, animal, experiments at Bethesda, Md., experiment station 60–61
experiments, small mammals 246
Indexing, work of Publications Division, 1909 611
Indian labor, cooperative experiments in Arizona, Nebraska, and New Mexico 278–279
Office, cooperation with Department on Indian reservation farm work 263
Plant Industry Bureau, demonstration farms 278–279
reservations, forest management, cooperation of Forest Service with Indian Office 98–99
forests, work of Forest Service, 1909 397–398
schools, Government, dairy cattle, testing with tuberculin 219
Indiana, paper-plant testing, experiments 286

Page.
Indians, advantages from Forest Service administration 98–99
  Arizona, agricultural education 278–279
  Nevada, agricultural education 279
  New Mexico, agricultural education 279
Ink, branding, meat-inspection work, quantity and cost 235
Insect control, demonstration in National Forests, cooperation of Entomology Bureau 506–507
  injury, forests, protection work, 1909 387
  inspection and quarantine law, necessity 44, 523–525
Insecticides, examination by Chemistry Bureau 439, 441
  investigations, Entomology Bureau 512–513
  study at Arlington Experimental Farm 340
Insects, cereal and forage-plant, investigations 513–515
  disease-carrying, work of Bureau of Entomology 113, 519–521
  injurious, introduction on imported plants 522, 523, 524
    to forest trees, study by Bureau of Entomology 109, 504–509
      pecan, study 528
      stored products, study by Bureau of Entomology 114, 521–522
  noxious, check by birds and animals 116
  scale, studies 115
  tobacco, control work, 1909 503–504
  useful, importations and exportations 108, 495–500
Inspection, animals, number and kind 199, 209–210, 213, 214–217
  apiary, laws, in several States, enactments and needs 526
  Board, Food and Drugs, advisory work 35–40
  butter, benefits to creameries 62–63
  exemption certificates 211–212
  export animals 53
  food and drugs, work of Chemistry Bureau 34, 35, 447–464
  forest products, for gipsy-moth infestation 107
  imported animals 53
  insects and nursery stock, need of federal legislation 44
  meat, work, Animal Industry Bureau, 1909 199–201, 208–212, 233–235
  nursery stock, need of federal legislation 44
  renovated-butter, scope of work 63
  work, Entomology Bureau, 1909 114, 115, 522–525
Inspectors, food and drugs, duties, changes and work, 1909 447–449
Instruments, weather, new work, 1909 171–173
Insular Experiment Stations, work of 1909 138–141, 693–701
Interior Department, in charge of Copper Center Station, Alaska 138
    issue of land patents for forest land 97
  Secretary, ruling on ownership of school lands in National Forests 399–400
Interstate inspection, nursery and orchard, law requirements 525
Iowa, breeding experiments, cooperative work, 1909 244–245
    Shire and Clydesdale horses 60–61
  hog-cholera serum, experiments 57–58, 236
  paper-plant testing 286
  plant-introduction garden 363
  Waterloo milk supply, dairy, cattle testing with tuberculin 219
Ipecac, adulteration practices 430
Iron, corrosion, laboratory studies, Public Roads Office 737–738
Irrigated land, drainage, cost per acre 147
Irrigation, arid regions, corn growing 300–301
  cooperation of Plant Industry Bureau and Reclamation Service 64–65
  excessive, injury to soil 145
  experiments, extension of work 703
  Great Plains area, studies 64–68
  humid regions, experiments in fruit growing 704
  investigations, Experiment Stations Office, review by Secretary 64–68, 142–145
  loss of water, checking methods 702
  methods of applying water in Alaska and Hawaii 693
  projects, cooperation of Federal and State authorities, experiments 64–65
  proposed work, 1910, 1911 704–705
  storage reservoirs in Montana and South Dakota, studies 330
  water supply, need of economical use 702–703

Page.

- Irrigation, water, utilization and prevention of waste, studies, 143–144
  - work, reports by States, 701
    - studies and experiments, 701–705
- Isthmian Canal Commission, cooperation with Department, on agricultural work in Canal Zone, 269
  - supplies, examination in New York laboratory, 453

- Jablonowsky, Josef, shipment of parasitic material for gipsy-moth work, 496
- Jack pine lands, growing of hairy vetch, experiments, 87
- Japan clover, development, study, 324
- Johne's disease, cattle, introduction from Island of Jersey, 221
- Jointworm, wheat, control by crop rotation, 112, 514
- Judgment, notices, 1909, remarks, 38, 617–618
- Juice, fruit, sterilization, study by Chemistry Bureau, 423
- Justice, Department, communications by Solicitor of Department of Agriculture, 741–783

- Kale, thousand-headed, use by Oregon dairymen, 325
- Kamala, adulteration, 430
- Kansas City laboratory, food and drug inspection work, 1909, 457
  - dry-land agriculture, methods, 64
  - Kharkov wheat, adaptability and production, 294
  - paper-plant testing, experiments, 286
  - scabies, eradication, 1909, 56
  - wheat-growing experiments, 418
- Kekchi cotton, important weevil-resistant variety from Guatemala, 303
- Kentucky, forest conditions, study, cooperative work, 1909, 398
  - paper-plant testing, experiments, 286
  - sheep scab, quarantine found necessary, 56
  - tobacco studies and experiments, 310–311
- Ketchup, tomato, preservation, studies by Bureau of Chemistry, 100
- Key West hurricane, October, 1909, history, losses, 47–48, 165–170
- Kharkov wheat, growing in West and Northwest, 294
- Khartoum sorghum, promising new grass for South, 366
- Kiosks, weather, description, installation in cities, 172
- Kites, use in upper-air observations, 155–156, 157
- Kuwana, Prof. S. I., shipment of parasitic material for gipsy-moth work, 496

- Laboratories, branch, food and drug inspection work, 1909, 449–464
  - contract, proposed work, 469
  - grain, standardization work, 292–293
  - microchemical, investigations, 445
  - physical, Plant Industry Bureau, work, 320–321
  - seed, work, 83, 291–292
  - sugar, work in 1909, and proposed work, 428–429, 468
- Laboratory investigations, Soils Bureau, 1909, 488–490
  - Synthetic Products, work, 1909, 437
  - work, meat inspection, 1909, 233–235
- Laborers, unclassified, assignment, executive order, 814
- Lacey Act, enforcement, 773–774
  - violations, disposal of cases, 43, 123, 549, 773–774
- Lactometer, new device for studying solids, 254
- Lambs, feeding tobacco for worms, experiments, 238
  - worms, control experiments, 238
- Land claims, National Forest, examination by Forest Service, 97
    - settlement, etc, 375–379
  - denuded, reforesting by Forest Service, acreage, 78
  - logged-off, clearing, study of methods, 333
  - Office, action on claims in National Forests, 376, 378
  - patents, forest lands, issue by Department of Interior, 97
- Lands, grazing, state and private, cooperation with Forest Service, 394
  - irrigated, drainage problems, importance, 145–147
  - school, National Forests, ownership, ruling of Interior Department, 399–400
- Landscape work, Arlington Experimental Farm, 341
- Lantern slides, Forest Service, loan or sale, 1909, 408
- Larkspur, poisoning of stock, investigations, 75, 283, 285

Page.
Lath, reed, experiments and results ... 362
Lathyrus tingitanus, green manure, use in California ... 368
Law, Federal, advantage from enactment of criminal code ... 123
  game, Alaska, enforcement, 1909 ... 545
  insect inspection and quarantine, necessity ... 523–525
  officer, Department, review of work ... 42–44
  rodent suppression, California enactment ... 119
Laws, apiary inspection, several states, enactments and needs ... 526
  enforcement, Forest Service cooperation ... 378–379
  game, index and summary, preparation, Biological Survey ... 546
  interstate, plant inspection, requirements ... 525
Lead arsenate, investigation as to effects on foliage ... 441
    use in control of tobacco flea-beetle ... 503
      with self-boiled lime-sulphur wash, results ... 512
  chromate, use in adulteration of coffee, prosecution ... 39
Leathers, examination by Chemistry Bureau ... 442, 444
Lectures, good roads, work of year ... 149
Legal operations, Department of Agriculture ... 41–42, 739–789
Legislation, game, progress of index ... 546–547
  inspection of insects and nursery stock, necessity ... 44
  new, in support of bird protection ... 123
  ordinances for rat extermination, remarks ... 118
Legumes, green-manure crops, investigations in California ... 367–368
  inoculated, value as tobacco fertilizer ... 273
  native, relation to crop production and rotation, studies ... 330
  use in South, work of farm management ... 86
Leitchee, Chinese, grafting experiments in Florida ... 362
Lemon, American, quality, note ... 79
  by-products, study ... 347
  industry, California, study ... 348
  Italian, industry, study ... 347
Lemons, California, handling and marketing ... 78
  curing and sweating, investigations ... 282
  packing-house methods, studies ... 284–285
Lespedeza, valuable Japanese clover ... 324
Lettuce, crossing experiments and results ... 356
Leucocytes in milk, investigations ... 225
Library, Department, additions, 1909 ... 670
    appropriations and estimates ... 561
    catalogue cards added ... 671–672
    growth of force, 1881–1909, classification and principal officers ... 801, 810
    periodicals, receipt and circulation ... 673–674
    report of Librarian, 1909 ... 669–682
    use of books ... 675–676
  of Congress, cooperation with Department Library ... 679–680
  publications, 1909 ... 641
  Statistics Bureau, contents, scope and value ... 657–658
  Weather Bureau, additions and work, 1909 ... 179
  work and accessions, review by Secretary ... 132
Licenses, hunting, statistics ... 548
Light, study of polarization in Weather Bureau, 1909 ... 156–157
Lily, Easter, bulb industry, establishment in United States ... 356
Lime and sulphur wash, use against rabbits ... 119
  beneficial effects on soil ... 486, 487
  use with sugar beets, note ... 77
Lime-sulphur self-boiled wash, use as insecticide ... 512–513
  spray, self-boiled, use in control of peach brown-rot ... 270
  wash, self-boiled, experiments ... 270
Lip-and-leg ulceration of sheep (necrobacillosis), outbreak ... 204, 225
Litigation, Forest Service cooperation ... 378–379
Little-peach, disease, control, experiments ... 269
Live stock, breeding experiments in Porto Rico ... 140
  injury by smelter fumes ... 229–230
    from cotton-seed meal, studies ... 60
  number grazing in National Forests ... 92

Page.
Live stock, Porto Rico, experiments 699
shows, danger of spread of tuberculosis 203
Liver disease, cattle, post-mortem appearance 222–223
Loblolly pine, Maryland reforesting, experiments, Forest Service 401
Loco disease, studies and results 283
plant, proposed investigations 75, 285
weed, studies of poisonous effect on stock 283
Logged-off land, cooperative studies of clearing methods 333
Logging methods, National Forests, fire protection and timber saving 99
Long Island, chestnut bark disease, control, experiments 271
Louisiana, hemp-growing experiments 287
rice-growing experiments 71
Lumber Manufacturers' Association, National, cooperative work on forest statistics 402
price lists, publication by Forest Service 403
sap-staining or bluing, loss to lumbermen, and treatment 405
Lymphangitis, epizootic among horses, studies 59–60
Lymphatic glands, disease in hogs 223

Machinery, farm, relation to profits, study 87
Mailing, work of Publications Division 605–608, 612
Maine, gipsy moth work, 1909 493
poultry breeding and feeding, studies 61
Mallein, distribution, 1909 .... 59, 238
Mammalogy and ornithology, economic, work, 1909, and proposed work 533–541, 549
Mammals, foreign, importation 123, 543
game. *See* Game.
study, importance of work 115
Manganese in soil, effect on pineapple as cause of yellowing 140
Mange, cattle, coal-tar dips, experiments 239
See also Scabies.
Mango, East Indian varieties, studies 361
foreign, use in plant propagation 357
stock, scale insects, introduction 522
Mangosteen, grafting experiments in Panama Canal Zone 361
Manure, green, value of young barley 418
Manures, farm use, investigations 332
Maple sirup and sugar, adulteration, investigations 428
Margaropus annulatus, experimental work, 1909 520
Marine Division, Weather Bureau, work, 1909 176–179
work, Weather Bureau 49
Marine-Hospital Service, cooperation in study of ground squirrels 535
rats 118
Marketing, cooperative, successful work 81
fruit, discussion 78–80
Markets, cattle and hogs, diminished supply, cause of higher prices 22–23
four leading, receipts of cattle, cause of decline 26
Marsh rabbit, identity with muskrat, note 120
Maryland, apple-leaf diseases 269
foot-and-mouth disease, eradication methods and results 53–55
quarantine for foot-and-mouth disease, 1909 .... 196–197, 214
soil surveys, cooperation of State 477, 481
tobacco experiments, expansion of work 310
Massachusetts, cranberry diseases, study 271
gipsy moth work, 1909 492
Northampton, technology school, establishment 135
tobacco investigations 311
white pine disease, study 272
Matting-plant, investigations and experiments in the South 362
McCabe, Geo. P., report as Solicitor of Department, 1909 739–789
Meadows, depleted, soil fertility studies 322
grasses, study 364
Meal, cotton-seed, injury to live stock, investigations 60–223
Meat animals, diminished supply, effect on supply of meats and lard 23
consumption, decline in United States, causes 20–21
decrease per capita and of certain kinds 18–19
per capita, various countries 18

Page.

Meat cost, retail, factors, etc. 17–18
  examination methods, ammonia determination, study 420
  food products, laboratory examination, 1909 233
  inspection appropriation, 1909 52
    laboratory work, 1909 233–235
    law, enforcement 43
    regulations, studies of tuberculosis and results 59
    State, need of laws 201
    value and economy of trained force 51–52
    violation of regulations, cases, disposition, etc 782–783
    work, Animal Industry Bureau 52–53, 199–201, 208–212, 233–235
  muskrat, palatability, marketing, etc 120
  price movements, investigations 23–24, 30–31
  prices, increase of retail price over wholesale in 50 cities 16–17
    special investigations, results 15–18
  products, preparation under supervision of Animal Industry Bureau 210, 211
  supply, conditions affecting 18–23
Meats, curing, investigations 234
  preparation under supervision of Animal Industry Bureau 210, 211
Medicago falcata, Asiatic, dry-land alfalfa 358
    new variety of Siberian alfalfa 356
  platycarpa, hardy alfalfa for Minnesota and Wisconsin 359
  ruthenica, Asiatic dry-land alfalfa, valuable for Northwest 356, 358–359
  sativa, hardy type of alfalfa 356
    See also Alfalfa, Grimm.
Medicines, patent, fraudulent claims, investigation 101
Melon worm, control, use of arsenate of lead 516
MELVIN, A. D., report as Chief of Animal Industry Bureau 195–259
Memphis, Tenn., milk supply, score 258
MERRIAM, C. HART, report as Chief, Biological Survey, 1909 533–551
Messenger boys, apportionment, executive order 814–815
Metabolism, phosphorus feeding, studies 420
Meteorological instruments, work, 1909 171–173
  records, publication, new method 50
Methyl salicylate, adulterant of wintergreen oil, detection 432
Mexican cotton-boll weevil. *See* Boll weevil.
Meyer, Frank N., studies of arid land fruits and crops in China 69
Mice, field, control, natural enemies and poison 535–536
    destructiveness to crops, remarks 119
  white-footed, technical study, note 122
Michigan, boys' corn clubs, organization 687–688
  foot-and-mouth disease, eradication methods and results 53–55
      outbreak and spread 196, 198, 214
  forest conditions, study, cooperative work, 1909 399
  grape diseases, study 271
  potato growing, studies 328
  quarantine for foot-and-mouth disease 196–197, 214
Microchemical Laboratory, investigations 445
Milk adulteration, inspection work by Bureau of Chemistry 100
    prosecutions, assistance of local inspectors 448, 455
  city supplies, investigation and improvement 207, 218, 250, 258
  composition, study 254
  evaporated, investigations 428
  human, investigations, results 254
  improvement in quality, experiments, discussion and methods 63
  inspection, score-card system, use and results 63
    work of Bureau of Chemistry 100
  investigations, 1909 254–255, 258–259
  leucocytes, investigations 225
  market, investigations in 1909 207, 218–219, 258–259
    of cities, examination by Chemistry Bureau 427–428
  pasteurized commercially, study 62, 242
  sanitary market, study of dairy management 332
  sickness, investigations in Tennessee 60, 230–231
  supply for cities, improvement 39, 63
  tuberculous cows, cause of tuberculosis in hogs 59
Milking utensils, combination, patent applied for 259

Page.
Milksickness, cause, investigation 283
Milkweed, eradication, study and methods 325–326
Millet, Black Voronesh, best variety 295
    proso, adaptation to Northern Plains States 295
    Siberian, growing in dry-land regions 65, 66
Mining claims, National Forests, examination and settlement 375–376
Minnesota, cattle-breeding experiments 60–61, 245–246
    farm water supplies, investigation 273–274
Mississippi Delta, boll-weevil studies 502
    soil surveys, cooperation of State 477, 481
Missouri, paper-plant testing, experiments 286
    soil surveys, cooperation of State 477, 481
    spraying of apples 270
Mistletoe, diseases, investigation 272
Mohler, John R., investigation of foot-and-mouth disease outbreak 54–55
Moisture, conservation, cooperation of Plant Industry Bureau and Reclamation
        Service 64–65
    studies in corn-growing in the South 71
        Great Plains area 64
Moles, investigations 537, 550
Moneys, public, receipts from various sources 557–558
Mongoose, destructiveness, danger of introduction 542
Montana, bison range, establishment and fencing 544
    dry-land agriculture, methods 64
    experiments in dry-land cereals, selection 67
    irrigation projects 65
    lip-and-leg ulceration, sheep, outbreak 225
    necrobacillosis in sheep 58–59
    scabies, eradication, 1909 56
MOORE, WILLIS L., report as Chief of Weather Bureau, 1909 155–193
Moose, killing in Alaska, notes 124
Morphin sulphate, use in so-called addiction cures 435–436
Mosquito, danger from sewer traps 520
    destruction by shore birds 540
Mosquitoes, control, studies by Bureau of Entomology 113
Moth, brown-tail, importation on plants from France 114, 523
        See also Brown-tail moth.
    flour, Mediterranean, fumigation experiments 522
    gipsy, parasite introduction 108
        work of Bureau of Entomology 107, 108
        See also Gipsy moth.
Mount Weather Observatory, work, 1909 155–158
Mountain sheep, killing in Alaska, note 124
Muck land, reclamation methods and crop adaptability 331
Mulberry scale parasite, establishment in Italy 108
Muskrat, closed season, suggestion 120
    fur-bearing, importance, investigations and suggestions for raising 120, 538
Mutton, demand, effect of high prices of beef and pork 23

Nashville laboratory, food and drug inspection, installation, 1909 457
    Tenn., milk supply, score 258
National Forests. *See* Forests.
Navy Department, cooperation of Forest Service 99
Nebraska, dry-land agriculture, methods 64
    Omaha milk supply, testing dairy cattle with tuberculin 219
    scabies of sheep and cattle, eradication, 1909 56
Necrobacillosis, sheep, Animal Industry Bureau studies in Wyoming and Montana 58–59
    outbreak of lip-and-leg ulceration 204, 225
Negroes, cooperative demonstration work in South 338
Nevada, cooperative investigations of organic decay and nitrification in soil 273
    drought-resistant fruits, experiments, etc 279
    irrigation projects 65
New Hampshire, forest taxation, study, cooperative work, 1909 398
    gipsy moth work, 1909 493
    white pine disease, study 272

Page.
New Jersey, cooperative study of grape industry 350
    cranberry diseases, study 271
    grape diseases, study 271
    soil surveys, cooperation, Department 477, 481
New Mexico, drought-resistant fruits, experiments, etc 279
    scabies, eradication, 1909 56
New Orleans laboratory, food and drug inspection, work, 1909 457–458
New York, experiments in controlling peach diseases in Niagara County 269
    foot-and-mouth disease, eradication methods and results 53–55
        number and value of animals slaughtered 54
    grape diseases, study 271
    laboratory, food and drug inspection work, 1909 458–459
    quarantine for foot-and-mouth disease 196–197, 214
    soil surveys, cooperation of State 478, 481
    tobacco experiments 311–312
Nitric acid, use in necrobacillosis 226
Nitrogen, determinations, methods, improvement, study 447
    peroxid, use in bleaching flour, reference to the courts 36, 41
Normal schools. *See* Schools.
North Carolina, cattle tick, eradication 55–56
    soil surveys, cooperation of State 478, 481
    tobacco breeding work 310
North Dakota, clover suitable for Great Plains, experiments 277
    dry-land agriculture, methods 64
    experiments in selecting dry-land cereals 67
    scabies, eradication, 1909 56
    selection of varieties of winter wheat, studies 67
    soil surveys, cooperation of State 478, 481
Notices of judgment, demand, and value; work of solicitor, etc 759
Nuns, Japanese (birds) entry refused 542
Nurseries, forest trees, for reforesting denuded land 98
    National Forests, list, capacity, number of trees 389
Nursery stock, imported, inspection for insect infestation 114–115
    inspection, foreign countries, systems 524
        need of Federal legislation 44
    work, Arlington Experimental Farm 341
Nut, pistache, Chinese, valuable grafting stock, studies 275
Nutrition, agricultural products, proposed study with respiration calorimeter for 1910 708–709
    animal, experiments at State College, Pennsylvania 60–61
    investigations, Experiment Stations Office 142, 708–709
        results, distribution of information 709
    orchard, experiments 270–271
    plant, investigations 264–265, 315–316
Nuts, breeding and adaptation, work 274–277

Oat crop, 1909, value and yield, comparison with previous years 11
Oats, blade blight, investigations 298
    cropping systems in dry-land farming, studies 64
    gray winter, use as cover crop for tobacco 314
    rolled displacement of meat in dietary 21
    varieties, studies and experiments 298
    winter, study 70
Oberthür, René, shipments of parasitic material for gipsy moth work 496
Object-lesson roads, construction, cooperation of States 148
Observatory buildings, Weather Bureau, owned and rented, 1909 186–187
    Mount Weather, work, 1909 155–158
Ocean charts, description, number of copies 595
    work of Weather Bureau, 1909 177–178
Office, Experiment Stations, etc. *See* Experiment Stations; Roads; Secretary; Solicitor.
Ohio, tobacco investigations 311, 312
Oil, Chinese wood, experiments and results 360–361
    distillate and tobacco extract, use as spray for orange thrips 519
    pine, manufacture from pine waste, experiments 407

Page.
Oils, essential, investigations 432
    miscible, for spraying, experiments 134
    volatile, experiments in plant growing 281–282
Oklahoma, cattle-tick eradication 55–56
    scabies, eradication, 1909 56
Oleostearin, importation and manufacture 211
Olive, drought resistance in the Southwest, studies 276
    dry-land, studies 276
OLMSTED, VICTOR H., report as chief of Statistics Bureau, 1909 655–668
Omaha laboratory, food and drug inspection work, 1909 460
Onions, Bermuda, experiments in growing in Arizona 278–279
    Spanish, seed tests 343
Ophthalmia, infectious, cattle, studies 60, 220–221
Opium habit remedy, inspection and condemnation 40
Opuntia ficus indica, species of prickly pear 335
Orange, hybridization experiments and results 276
    industry, comparison of Florida with California 348
    thrips, injuries and control, investigations 113, 519
    trifoliate, experiments in crossing with citrange 276
Oranges, Florida, marketing and handling 79
Orchard birds, food, study of character 121
    diseases, control, studies 269–271
    pests, study, Arlington Experimental Farm 340
Orchards, deep plowing for destruction of pear thrips 509
Orders and regulations, preparation, importance, etc 783, 784
Oregon, experiments in selecting dry-land cereals 67
    irrigation projects 65
    Rogue River Valley, experiments in eradication of pear-blight 269
    studies of tuberculosis 59
    wild prunes, economic value 289
Organic matter in soils, investigations 486
Ornithodoros megnini, investigations 521
Ornithology and mammalogy, economic, work, 1909, and proposed work 533–541, 549
Osier-willow, cooperative studies 340
Oysters, pollution, studies 422
Ozark region, apple diseases, control and demonstration 270
Ozarks, spraying orchards, demonstration work 511

Pacific Coast, effect of fungous diseases on deciduous fruits 269
    experiments in breeding hops 282
    States, per cent of National Forest timber 384
    studies of orchard diseases 271
Packing house water supply, sanitary requirements 234
Padda oryzivora, ricebirds, entry refused 542
PAGE, LOGAN WALLER, report as Director of Office of Public Roads, 1909 711–738
Palestine, Mount Hermon, studies of wild wheat 69
Panama, Canal Zone. *See* Canal Zone.
Panicum grass, studies 290
Paper-making materials, study by Bureau of Chemistry 101, 406, 407, 443, 446
    plant investigations, remarks 84
        Japanese mitsuma, experiments in paper making in Georgia 362
    plants, fiber value, experiments in several States 286
Papers, testing, Bureau of Chemistry 101, 442–443, 446
Paprika pepper, growing, experiments in South Carolina 280
Para grass, valuable crop for South 365
Parasite of tick, experiments 521
Parasites, animal, investigations, 1909 238–240
    beneficial, importations and exportations 108, 495
    boll weevil, introduction and work 501, 502
    gipsy and brown-tail moth, importations and laboratory work 495–498
    green bug, investigations 513–514
Paris green, use against tobacco hornworms, experiment 503
    with lime-sulphur self-boiled wash, results 512
Partridges, importations for stocking game covers 123, 543, 547
Pasture crops, improvement, study 86
    grazing methods and experiments 365

Page.

Pasture lands, National Forests, reseeding, experiments 395–396
  See also Grazing.
Pastures, coyote-proof, experiments and results 288
Patents, applications by employees, disposition, etc 787
  land, to forest lands, issue by Department of Interior 97
Pathological collections and inspection, Plant Industry Bureau, cooperative work 266–267
  Division, Plant Industry Bureau, work 265–268
Pathology, laboratory work 265–266, 271–272
  plant, discussion of problems 71–74
Pea, Tangier, use as legume in California 368
Peach, wild, China, experiments in grafting with various fruits in arid regions. 68
  yellows, control, experiments 269
Peanuts, pressed cakes, poisonous to stock, supposition 224
  varieties, study and experiments 344
Pear blight, eradication work 72, 269
  prickly. *See* Prickly pear.
  thrips, life history, study, and control experiments 110, 509–510
Pears, codling moth, studies 511
Peas, Canadian field, success in growing in dry-land sections 65
Peat acidity, requirements for growing blueberries 419
Pecan bud-moth, investigations 528
  culture, note 80
  scab, control methods, study and investigations 73, 269–270
  varieties, study of adaptability and self-sterility 352
Pedigree record associations, supervision 248
Pellagra, relation of corn to the disease, note 75
Pennsylvania, chestnut bark disease, study 271
  foot-and-mouth disease, eradication, methods and results 53–55, 196–197, 214
    number and value of animals slaughtered 54
  hemp growing, cooperative experiments 287
  soil surveys, cooperation of State 478, 481
Pepper growing in South Carolina, remarks 74, 280
Peppermint oil, investigations 432
Perfumery plants, oil-yielding, studies 281, 282, 284
Peridermium strobi. *See* White pine, disease.
Permits, grazing, National Forests, number and kinds, 1909 392–393
Persimmon, experiments in grafting in the South 69
Persimmons, Japanese, astringence, removal, alcohol method 423
Personnel, committee, investigations 788
Peruvian alfalfa. *See* Alfalfa, Peruvian.
Pests, insect, introduction on imported plants 522, 523, 524
Petune, use in improving tobacco aroma, experiments 313
Pheasants, golden, disease caused by *Heterakis papillosa* 224
  varieties, introduction, and propagation 123, 543, 547
Phenacetin, injurious effects, investigations by Chemistry Bureau 101, 434–435, 437
Phenol dips, cattle mange, experiments 239
Phenological data, forestry, collection by volunteer observers 401, 408
  investigations, data 333
Philadelphia laboratory, food and drug inspection work, 1909 460
Phosphatic deposits, mapping by Geological Survey 490
Phosphoric acids, quality, investigations 431
Photographic work, Publications Division, 1909, summary by Bureaus, etc 609–610
PINCHOT, GIFFORD, report as Forester, 1909 371–413
Pine, loblolly, reforesting experiments, Forest Service 401
  trees, protection from gipsy moth 494
  white, diseases, studies 272, 505
  yellow, handling and preserving, methods, cooperative studies 405
    waste, utilizing 407
Pineapple disease caused by manganese in soil, study 140, 697
  work, Hawaii and Porto Rico 140, 697–698
Pistache nut, Chinese, introduction, characteristics, studies 275

Page.
Pistache tree, Chinese, value for nuts and for shade 69
Pistacia chineusis, nut, valuable grafting stock, studies 275
Pittsburg laboratory, food and drug inspection work, 1909 461
Plague, bubonic, transmission by rats and squirrels 116, 118, 534, 535
Plant breeding, alkali and drought-resistant 319–320
experiments, studies, and cooperative demonstrations 306–307, 313–316, 319–320
superiority of line breeding 306
diseases, study and control 265, 268
food, absorption by plants, work, Chemistry Bureau 419
Industry Bureau, business operations, 1909 261–262
cooperation with other executive services 263
estimates and appropriations for 1910 .... 560, 562
growth of force, 1881–1909, officers, 1909 .... 795–796, 805–806
organization and policy, 1909 262–263
publications, 1909, new and reprints 262, 641–649
report of Chief, 1909 261–370
review of work by Secretary 64–89
introduction gardens, remarks 85–86, 362–363
introductions, inspection by Entomology Bureau 522
mitsuma paper, cultivation, studies in Georgia 362
nutrition, investigations, scope 264–265, 316
studies, Arlington Experimental Farm 342–343
pathology, laboratory work 71–74, 265–267
testing gardens, remarks 85–86
Planting plans, private forests, work of Forest Service 400
Plants, cereal, nutrition experiments 296
Congressional distribution 368–369
cooperative studies of economic collections 290–291
distribution at plant-introduction gardens 362–363
drug, investigations 279–281
forage, alkali-resistant studies 319
foreign, introduction, cooperative work 280
purchase and distribution, work 357–363
wild and cultivated, varieties and method of securing 358
hybridization and propagation 356–357
imported, inspection for insect infestations 72, 114–115
matting, study and experiments 362
medicinal, investigations 279–281
miscellaneous, identification, study 291
native, vegetation, value, studies 320
ornamental, identification and cataloguing 291
perfumery, experiments in growing 281–282
study of oil-yielding properties 284
poisonous, eradication, investigations 279–281, 283, 395
propagation, study of new methods 357
useful, Southwest and Mexico, studies 290
wild, geographic distribution, remarks 121
Plowing, deep, for destruction of pear thrips 509
fall, for control of tobacco hornworm 503
Plum, study of economic value in Oregon 289
Poa arachnifera, alfalfa hybrid 356
pratensis, alfalfa hybrid 356
Poison in vegetation, caused by smelter fumes 229
ivy, eradication, proposed investigations 285
prairie dog, suggestions for use 119
squirrel, suggestions for use 118
Poisoning, stock, cooperative studies of conditions in National Forests 283–284
Poisonous plants, eradication, National Forests, 1909 395
investigations and proposed work 75, 279–281, 283, 285
substances in fabrics, wall papers, etc., study, Chemistry Bureau .. 439, 468
Poisons, rat, notes on use 117
Polarization, skylight, studies, Weather Bureau 46
Pole sweat, tobacco, control, suggestion 75
Pomology investigations 345–354
Pork, exports, 1851–1909, statistics 19–20
prices, comparative 29–30

Page.
Pork, prices, effect of price of corn and diminished marketings of hogs..... 22–23, 29
  products, wholesale prices, comparative........ 30
Portland laboratory, food and drug inspection work, 1909........ 461
Porto Rico Experiment Station work........ 693, 694, 698–699
      review by Secretary........ 140–141
    Jersey cattle introduction........ 252
    live-stock diseases and conditions........ 220
Post-Office Department, cooperation of Chemistry Bureau........ 433
      rural delivery, cooperation of Public Roads Office.... 149
Potash, experiments in tobacco nutrition........ 316
Potato, cooperative botanical studies........ 291
  crop, 1909, value and yield, comparison with previous years........ 11
  disease resistant varieties, studies........ 81, 268, 291
  growing, cooperative studies........ 331–332, 328
    under irrigation and on dry land, experiments........ 297
  Irish, variety tests, Arlington Experimental Farm........ 343
Potatoes, promising new varieties from Chile........ 358
  seed, germination, cooperative studies........ 332
  sweet, variety tests, Arlington Experimental Farm........ 343
Poultry, cold storage, investigations and proposed work........ 102, 427
  diseases, study........ 59, 60, 224
  investigations, 1909........ 61, 247–248
  tuberculosis, Oregon, studies........ 59
    transmission to swine, investigation........ 228
Prairie dogs, destructiveness and control........ 119
Prescription scheme remedies, examination........ 101, 434
Preservatives, dangerous, use in foods, practical cessation........ 40
    effect on yeast organisms, study........ 420
Preserves, game, private, investigation, and collection of data........ 547
Prickly pear, breeding to produce a spineless form........ 88
    spineless, distribution of cuttings by Department........ 88, 336
    use as forage........ 88, 335
Printing, branch office, work and cost, 1909........ 611–612
  expenditures, 1909, by bureaus and classes of publications........ 601–602
Propagation, plants, work and results........ 356–357
Protection, game, work, 1909, and proposed work, 1910........ 542–549, 550–551
Protein content of wheat, effect of soil and climate, studies........ 100
Protozoa, parasitic, investigations........ 240
Prune, Oregon wild, economic value, study and description........ 289
Prunus glandulosa. *See* Almond, desert.
  oregana, promising variety of Oregon prune........ 289
  subcordata, promising variety of Oregon prune........ 289
Pseudo-leukemia, hogs, post-mortem appearances........ 60, 223
Pteromalus, enemy of brown-tail moth, laboratory work........ 497
Ptomaine poisoning, canned meat, investigations........ 200
Public Roads Office. *See* Roads.
Publication work, summary, 1909........ 591–592
Publications, agricultural, reissued by Superintendent of Documents, 1909.. 599–600
    Chemistry Bureau, 1909........ 464
    Department, 1909, classified by bureaus contributing........ 592–594
      distribution, amount and details of work, 1909..... 605–609
        to foreign countries, work of Library... 132
      issued, 1909, list........ 127, 614–654
      output, 1907, 1908, 1909, comparison........ 594
      reprinting........ 128
      sale, growth in returns and use of receipts.... 128, 598–600
    Division, appropriations, 1908, 1909, 1910........ 600
      estimates and appropriations for 1910........ 561, 563
      growth of force, 1881–1909, officers, 1909........ 800, 809
      publications, 1909, new and reprints........ 649–650
      report of Chief, 1909........ 591, 654
      review of work by Secretary........ 127–129
    new, pages and illustrations, output of 1909........ 604
    Office of the Solicitor........ 788
    Plant Industry Bureau, issue for 1909........ 339
    Weather Bureau, printing and distribution........ 183, 185
Pyrheliometers, improvement, study and progress, 1909........ 157

Page.
Quail, importations for stocking game covers 123, 543, 547
Quarantine Division, work, 1909 215–220
    foot-and-mouth disease, 1909, areas released, etc 54, 196–197, 214
    imported animals 53
    law and regulations, violations, disposition and status of cases . 43, 777–781
        insect pests, necessity 524
    necrobacillosis in sheep, establishment 58–59
    scabies of cattle, areas released in 1909 56
        sheep, areas released in 1909 56
    Texas fever, areas released, 1909 . . . . 55–56, 212
Quinquennial census, agricultural, provision for by law 666

Rabbit marsh, use as food, note 120
    pest, remedy by use of lime and sulphur wash 119
Rabbits, North America, distribution and habits, investigations 122, 541
Rabies, dog, muzzling recommended as preventive measure 58
    experiments and results in Washington, D. C 58
    investigations, 1909, cases diagnosed 226–228, 243
Radiation, solar, measurements, study by Weather Bureau, 1909 156–157
Radol, cancer cure, examination 433
Railroad lands, grazing, cooperation with Forest Service 394
    specials for instruction in agriculture, work of year 137
Railroads, prosecutions for violation of transportation regulations 779–781
Rainfall, relation to crop production 483
Ramona stachyoides, perfumery-producing plant of California 282
Range investigations, cooperative experiments in Arizona 336–337
    lands, overgrazed, natural reseeding, experiments and results 288–289
    management, work, 1909 . . . . 287–291, 335–337, 390–396
    uses, National Forests, prevention of monopoly 92
Ranges, reduction, effect on meat supply and prices 21
Rat virus, testing, Biological Survey 237, 533
Rats, extermination, suggestions, ordinances for suppression, etc 116–117
    house, control studies 533–534
    kangaroo, depredations and control 537, 549
    plague transmission, and spread to human beings 116, 118, 122, 534
Reagents, chemical, testing by Bureau of Chemistry 101
Reclamation, muck land, study 331
    project, Truckee-Carson, cooperative studies of crop physiology and breeding 279
    projects, soil survey work and needs 480–481
    Service, United States, cooperation with Department in arid region studies 263
Recommendations, Secretary 44, 55, 58, 129, 150
Reconnoissance surveys, work, 1909 . . . . 473, 474, 475
Record, Experiment Station, scope of work 134
Reed-lath matting, study and results 362
Referee Board, Consulting Scientific Experts, duties and personnel 37–38
Reforesting denuded land by Forest Service, acreage 98, 388–389
Refrigeration, plant for use in fruit shipping, note 79
Refuges, game, remarks 124
Regulations and orders, preparation, importance, etc 783–784
Remedies, prescription scheme, examination 434
Renovated butter, inspection, 1909 . . . . 63, 259
Rent, Department buildings in District of Columbia, note 126
Reports, crop, collection and handling, Statistics Bureau 130–132
Representatives, quotas of Farmers' Bulletins, disposal 129
Reseeding range lands in National Forests, experiments 395–396
Reservoirs, storage, irrigation studies in Montana and South Dakota 330
Respiration calorimeter, studies 142
Rhipicephalus texanus, discovery and experiments 521
Rhode Island, chestnut bark disease, study 271
    gipsy-moth work, 1909 494
Rhodes grass, promising new variety 365
Rice blast, experiments with rice in South Carolina 297
    blight-resistant, studies 71
    crop, 1909, value and yield, increase over previous years 12–13

Page.
Rice, demonstration work in Mississippi........ 338
    disease-resisting, experiments in South Carolina........ 297
    experiments, expansion of work........ 297
    oriental, mineral coating, examination, Seattle laboratory........ 464
    straw, paper-making experiments........ 84, 406
Ricebirds, Java, entry refused........ 542
Richmond, Va., milk supply, score........ 258
Ritsema Bos, inspection certificate, Holland, reliability........ 524
River and flood service, work and new districts........ 48–49, 170–171
    gauges, automatic, value........ 172
Road building, crushed stone, study of substitutes........ 712–713
        expert advice, aid of Department........ 713–714
        value of slag, investigations........ 713, 736
    construction and maintenance, methods........ 734–735
    convention, Paris, 1909........ 148, 712
    improvement, State aid and expenditures........ 711
        work of Roads Office, 1909........ 711–715
    materials, laboratory tests in various States........ 736–737
        tests, cooperative work with Geological Survey........ 734
Roads, construction, National Forests, cost, and State assistance........ 396–397
    dust preventives, investigations........ 148, 712, 735–736
    earth, methods of construction, location, cost, etc., work of Public Roads Office........ 721–723
    engineering, highway, instruction to students........ 150, 714, 731–732
    foreign countries, construction, etc., investigations........ 714
    gravel, methods of construction, location, cost, etc., work of Public Roads Office........ 719–721
    macadam, injury by automobiles, prevention studies........ 712
        methods of construction, location, cost, etc., work of Public Roads Office........ 716–719
    object-lesson, construction, cost, etc........ 148–149, 711–712, 715–731
    Public, Office, cooperation with other bureaus, etc........ 149, 714
            Director, selection as chairman roads commission, Paris, 1908........ 712
            estimates and appropriations for 1910........ 561, 563
            exhibit at Alaska-Yukon-Pacific Exposition........ 149, 714
            experimental investigations, 1909........ 712–715
            growth of force, 1893–1909, officers, 1909........ 802, 810
            inspection and advice, assignment of inspectors........ 732–734
            lectures and advisory work........ 149
            proposed work........ 738
            publications, 1909, new and reprints........ 650–651
            report of Director, 1909........ 711–738
            study of corrosion of iron and steel........ 737–738
            work, review by Secretary,........ 147–150
    sand-clay, methods of construction, location, cost, etc., work of Public Roads Office........ 723–728
    shell, method of construction, location, cost, etc., work of Public Roads Office........ 721
Rodents, ditch borers, control, study........ 536–537, 549
        See also Mice; Prairie dogs; Rabbits; Rats; Squirrels.
Roosevelt elk, reservation, establishment........ 545
Root knot, cotton, wilt disease, studies........ 267–268
        tobacco, control by clean cultivation........ 76
    oxidation, influence on soils........ 488
    worm, grape, control, work of Bureau of Entomology........ 111, 512
Roquefort cheese, investigations........ 256
Rose, Rugosa, crossing results........ 357
Rosenau, Milton J., investigation of foot-and-mouth disease outbreak........ 54–55
Roses, hybridization, remarks........ 357
Rotundifolia grape, study and experiments........ 350
Roundworms, sheep, experiments and results........ 60, 238
Rubber trees, experiments in growing in Hawaii........ 140, 697–698
Rust, injury to white pine, remarks........ 73
Rusts, cereals, studies and experiments........ 297–298
Rye crop, 1909, value and yield........ 13

Page.
Saccharin, use in food, reference to Referee Board 38
Sage, black, promising perfumery-producing plant of Great Plains 281–282
    white, economic value as oil producer 282
Sake, Japanese beverage, investigation at Honolulu laboratory 457
Salaries, Weather Bureau, 1909 193
Salts, fertilizer, combinations, importance to soils 486
    plant, absorption by rain, dew, etc., study 418
    potash, experiments in tobacco nutrition 316
San Francisco laboratory, food and drug inspection work, 1909 462–463
"Sand-burn" investigations, Texas 60, 231
Sand-clay road construction adopted by several States 149
Sap-staining, lumber, treatment 405
Sapsuckers, injuries to trees 540
Sausages, water content, study 234
Savannah laboratory, food and drug inspection work, 1909 464
Scab, sheep, quarantine found necessary in Kentucky 56
Scabies, cattle, coal-tar dips, experiments 239
    sheep and cattle, eradication, 1909 56
    cattle and horses, inspection and dipping 213–214
    See also Mange.
Scale insects, new, discovery on imported plants 522, 523
    studies and control 115, 519
School, chemistry, experimental distilling of denatured alcohol 415
    lands, National Forest, ownership, ruling of Interior Department 399–400
Schools, agricultural graduate, establishment in Illinois and Massachusetts 135
    elementary, teaching of agriculture 136
    high, agricultural, establishment in different States 135
    movable, of agriculture, work of year, courses of study, etc 137–138
    need of instruction regarding birds and mammals 116
    normal, for instruction of Farmers' Institute teachers 137
Scientific investigations, need of encouragement 133
Scientists, salary, increase, recommendation 150
Score cards, dairy, result of use 63, 250, 258–259
Score-card system, milk supply, instruction given to local inspectors 63
Sea birds, life history, study 124, 544
Seattle laboratory, food and drug inspection work, 1909 464
Secretary, Agriculture. *See* Agriculture.
    Interior. *See* Interior, Secretary.
    Office, growth of force, 1881–1909; officers, 1909 .... 793, 794, 804
Sedge, Chinese matting, experiments in South 362
Seed, adulterated, studies 83, 292
    beds, tobacco, value of steam sterilization 311
    Congressional distribution 83, 368–369
    cotton, poisonous properties, investigations 223
    cowpeas, saving by improved method with machinery 86
    distribution, increase in appropriation 369
    farm, experiments in testing 291–292
    foreign, purchase and distribution, work 357–363
    pure, review of investigations 83
    sorghum, distribution to cooperating farmers 297
    sugar beet, single germ, experiments 308
    testing, laboratory experiments 83, 291–292
        plans for future work 292
        work, Forest Service, 1909 401
Seedlings, French, importations, introduction of insect pests 523
Seeds, for Congressional distribution, tests 344
    handling and grading, work, note 285
    samples of weed and economic plant, distribution 84
    vegetable, study of vitality 292
    weed, in feeding stuffs, studies by experiment stations 134
Seismological work, need of improvement 173
Semiarid regions, dry-land studies 316–318
    partial irrigation, demonstration farms 144
Senators, quotas of Farmers' Bulletins, disposal 129
Serum, antiabortion, study 60
    hog cholera, studies in manufacture and use 57–58, 60, 236
    infectious anemia of horses, experiments 230

Page.
Serums, supervision, legislation, need 55, 205–206
tuberculin, studies 60
Sewage, disposal systems, creameries and farms, study 252
Sewer traps, treatment with kerosene to destroy mosquitoes 113, 520
Shaftal clover, usefulness for cotton belt of South, etc., experiments 277
Sheep, breeding, work, Wyoming Experiment Station, 1909 60–61, 245
decrease in production 19
disease, paralysis of pregnant ewes, symptoms and control 221
farms, cropping systems, studies 326
fencing from wolves and coyotes 536
grazing, National Forests, number, and average size of flocks 92, 392
lip-and-leg ulceration, outbreak, symptoms, and treatment 58–59, 204, 225
mountain, killing in Alaska, note 124
necrobacillosis, studies in Wyoming and Montana 58–59, 204, 225
roundworm, eradication, experiments 60, 238
scabies, control work, 1900–1909 56, 213
Shellac varnish, use in confectionery adulteration, study 452
Shellfish, pollution, studies 422
Shipping grapes, California, study 79
Ships, fumigation for destruction of rats 534
Shore birds, food supply, note 121
Shorthorn milking cattle, breeding experiment, 1909 60–61, 245
Shrimp, "headless," canning experiments 425
Silage experiments, Porto Rico 141
Silkworm, food supply, study, Arlington Experimental Farm 340
Silo, experimental work, 1909 252
Silos, building in South 249–250
dairy, study of construction 61
Silvical leaflets, publication, 1909 401
Slag, furnace, road construction, experiments 149
Smallpox vaccine, contamination with foot-and-mouth disease 54–55, 198
Smelter fumes, effects on live stock through poison vegetation 229–230
Smut, loose, of barley, wheat, and sorghum 298
Smuts, cereals, studies and experiments 297–298
Smyrna figs, culture, study 274
Snowfall measurement device, description and results 50, 172, 175
study, mountain regions 49
Sodium benzoate, report of Referee Board 37
Soil bacteria, relation to fertility, studies by experiment stations 134
bacteriology, remarks 73
deterioration, causes 105
fertility, inexhaustible under certain conditions 105
depleted meadows, study 322
studies, United States and foreign countries 104–106, 485–488
improvement work, Arlington Experimental Farm, results 340–341
relation to water, investigations 483–485
survey, requests on file, 1909, by States 482
work, 1909, area and cost 103, 473–476
cooperation with State organizations 477–479, 481
since 1899 103
types, variety, characteristics, and adaptation to certain crops 105–106
Soil-climate experiments, Chemistry Bureau, 1909 418
Soils, arsenic accumulation after spraying, plant injuries, study 512
Bureau, cooperation with executive departments in plant studies 340
estimates and appropriations for 1910 561, 563
growth of force, 1895–1909, officers, 1909 798, 809
publications, 1909, new and reprints 651–652
report of Chief, 1909 473–490
work, 1909, review by Secretary 102–107
European, increased yield owing to intelligent methods 104–105
organic matter, investigations 486
Porto Rico, studies 140
translocation by various agencies, study 489
"Soft drinks," medicated, examination 435
Solar radiation measurements, study, Weather Bureau, 1909 46, 156–157, 173
recording apparatus, improvement 173
Solicitor, communications with Department of Justice 741–783

Page.
Solicitor, duties . . . 739–740
legal advice . . . 740
Office, publications . . . 617, 788
work, 1909, review by Secretary . . . 42–44
report, 1909 . . . 739–789
Sorghum, head smut, investigations in Texas . . . 298
Khartoum, promising African grass for South . . . 366
seed, distribution to cooperating farmers in Southwestern States . . . 297
midge, investigations . . . 515
Sorghums, experiments with dry-land crops in Northwestern States . . . 65, 66, 297
varieties, studies and results . . . 366
South Carolina, cotton breeding, varieties, selection . . . 305
experiments with blight-resisting rice . . . 71, 297
farm management, cooperative demonstration work . . . 322–323
pepper growing, experiments . . . 74, 280
tea culture, experiments . . . 74, 282
dairy industry, work of Animal Industry Bureau, 1909 . . . 62, 207, 249–251
Dakota, anthrax outbreak, 1909 . . . 219
experiments in dry-land agriculture, methods . . . 64
selection of dry-land cereals . . . 67
irrigation projects . . . 65
scabies, eradication, 1909 . . . 56
soil surveys, cooperation of State . . . 478, 481
water, studies . . . 484
studies in selection of varieties of winter wheat . . . 67
Southern States, demonstration work, cooperation of farmers . . . 88–89
leguminous crops, study . . . 69–70
pecuniary losses caused by cattle ticks . . . 202
Southwestern United States, study of useful plants . . . 290
Soy bean, varieties, studies . . . 366–367
Sparrow, English, extermination work in California . . . 539
Spelt, red winter, growing in Michigan . . . 295
Spirits, distilled, handling, investigations . . . 449
Spraying apples, demonstration, Missouri and Virginia . . . 270
Ozark region . . . 270
cranberry insects, experiments . . . 110, 511
pear thrips, experiments . . . 510
Sprays, dust and liquid, comparative value in orchard work . . . 511
See also Bordeaux mixture; Lime-sulphur wash; Oil distillate, etc.
Squirrels, Beechey ground, plague transmission . . . 535
ground, control, study . . . 535, 549
destructiveness and danger . . . 118
disease spreading . . . 118, 122, 535
extermination in California . . . 118, 535
St. Louis laboratory, food and drug inspection work, 1909 . . . 461
milk supply, examination . . . 428
Paul laboratory, food and drug inspection work, 1909 . . . 462
Stables, dairy, construction, study . . . 61
southern, experiments in ventilation . . . 63
Standardization, cotton, establishment of grades . . . 84–85, 263–264
grain, effect of investigations . . . 84–85, 293–294
Starter, dry, for butter making, investigations . . . 253
State appropriations for teaching agriculture . . . 135
forest work, cooperation of Forest Service . . . 99
Statistics Bureau, estimates and appropriations for 1910 . . . 561, 563
growth of force, 1881–1909, officers, 1909 . . . 801, 809
organization . . . 655–659
publications, 1909, new and reprints . . . 652, 666
report of Chief, 1909 . . . 655, 668
sources of information . . . 659–661
work, 1909, review by Secretary . . . 129–132
game, note . . . 125
special investigations . . . 132
Steel, corrosion, laboratory studies, Public Roads Office . . . 737–738
Stencils, use in addressing mail matter, Document Section . . . 606
Sterilization, seed beds, tobacco growing . . . 311
Stock breeding, experiments, Kodiak Island, Alaska . . . 139

Page.

Stock feed, poison in cotton-seed meal and pressed cakes from peanuts 223, 224
  poisoning, National Forests, cooperative investigations 283, 284
Storage foods, study by Bureau of Chemistry 102
  fruit, studies 78, 79, 285
Stored products, insects injurious 521, 522
Storm-warning stations, list 183
Straw, rice, study for paper making 79
  sedge, matting manufacture, study and results 362
Strawberry hybrids, experiments in Alaska 139
Straws, paper making, experiments 79, 406
Strychnine, use against rodents, notes 118, 120, 356
Students, engineer, instruction, Public Roads Office 150
    Weather Bureau, from Mexico 180
Stump lands, clearing and planting, studies 87
Subtropical garden, Miami, Fla., discontinuance, note 85
Sugar, analysis, methods, study 429
  beet, production and value, 1909 12
    See also Beet, sugar.
  cane, production and value, 1909 12
  consumption, per capita, increase 20–21
  content, sweet corn, effect of environment 416
  laboratory work, 1909, and proposed work 428-429, 468
  production and value, 1909, increase over previous years 12
Sugar-producing plants, investigations 428–429
Sulphur dioxid, use in food, reference to Referee Board 38
Sulphurous acid, determination in food, Gudeman method 453
Sumatra tobacco, experiments in breeding uniform type 312
Summer schools, work of agricultural colleges 136
Supplies, annual, advertising methods 557
    contract, examination of Chemistry Bureau 101, 444–445
Surveys, reconnoissance, of large areas by Soils Bureau 103
    soil, work since 1899, and for 1909 ..... 103, 473–476
Swamp fever among horses, studies 59–60, 230
  lands, need of drainage to control water supply 483
    reclamation, proposed studies in 1911 708
    surveys, importance and value 481
Sweet corn, bacterial diseases, experiments 266
    seed investigations 345
    See also Corn.
Swine, decrease in production 19
  tuberculosis, studies in Oregon 59
    See also Hogs.
Swiss cheese, work at Albert Lea, Minn., 1909 255
Synthetic products, investigations, Chemistry Bureau 437
      Laboratory work, 1909 437
Syracuse, N. Y., milk supply, score 258

Tannin crop, proposed experiments in growing 284
  sources, investigation 74, 282
Tanning materials, chemical study 282
Tar manufacture from pine waste, experiments 407
Tea culture, experiments with labor-saving machinery 282
    investigations and experiments in South Carolina 74, 282–283, 285
  farm inspection, scale insects from Japanese camellias 523
Teachers' courses in agriculture, provision in various States 135–136
Telangiectasis, liver disease, cattle, post-mortem appearance 222–223
Telegraph, wireless, service, Pacific coast, Weather Bureau, work, 1909 178
    work, Weather Bureau, 1909 184
Telethermoscope, introduction in weather stations 172
Tennessee, cattle tick, eradication 55–56
    cotton varieties, selection 305
    milk-sickness investigations 60, 230–231
    Winter barley, promising new beardless variety 299
Terpenes, lemon, detection in lemon oil, method 424
Testing gardens, plant, remarks 85–86
  stations, alfalfa, cooperative work in Northwest and Canada 278
  timber, cooperative work, Forest Service 405–406

Page.
Texas, Amarillo, experiment farm, note 296
    Brownsville, test garden, irrigation study and experiments 370
    cotton-breeding experiments 305–306
    crop conditions, note 324–325
    date gardens, study 275
    dry-land agriculture, experiments 64
        cereals, selection 67
    experiment farm studies of agricultural extension 318
    farms, number in 1900 337
    fever, control work, 1909 55–56, 201, 212
    San Antonio, study of prevalence of plant diseases 268
    "sand-burn" investigations 60, 231
    southern, lack of irrigation facilities, and results 325
    tobacco work and studies 312–313
    truck-crop insects, investigations 515
    wheat-growing experiments 417
Text-books, preparation by Experiment Stations Office for school use 136
Thielavia basicola, cause of tobacco root-rot, study 268
Thielaviopsis, fungus enemy of pineapple, study 267
Thrips, orange, injuries and control, investigations 113, 519
    pear, life history study, and control experiments 110, 509–510
    tobacco, study by Entomology Bureau 504
Tick, fowl, injury to poultry 521
    parasite, experiments 521
Ticks, cattle, control, demonstration experiments 55–56, 114, 239–240
        eradication, cooperation of Federal and State authorities 55–56
            experiments with arsenical dips 239–240
            work, 1909 55–56, 201–202, 212
        extermination, economic value, possibilities 56
        pecuniary losses from, in Southern States 202
        responsibility for spread of Texas fever of cattle 55–56
        Texas, experimental work, 1909 520-521
    varieties occurring in South, studies and discoveries 521
Timber, beetle-infested, barking, cost per tree 507
            utilization 508
    cut, National Forests, percentage of stand by States 93, 97–98
    lands, cut-over, soil surveys, importance and value 481
    National Forests, amount located in different States 98, 384
            receipts, 1909 379, 380, 385
            sales, amount, and value, 1909 384–387
                and free use, by States 97–98, 380, 387–388
            stand, distribution, and cut, 1909 93, 97–98, 383–384, 385, 387–388
    preservation, cooperative demonstration work with Forest Service 404–405
    storm-felled, injuries by insects 504–505
    testing, cooperative work, Forest Service 405–406
    trespass cases, litigation, 1909 378, 387
    waste, utilization by Forest Service logging methods 99
    yield, National Forests 92–93, 97
Timber-land owners' associations, cooperation with Forest Service 96, 383
Tin, effect on food character and composition 423
Tobacco, aroma improvement, experiments 313
    breeding, results 309–313
    cigar-filler, flavor and aroma, experiments with nicotine content 313
    citric acid treatment, experiments 313
    cover crops, winter, studies in production 314
    crop rotation, experiments 310
    crop, 1909, value and yield, increase over previous years 11–12
    curing, experiments in Connecticut 313
        new methods, remarks 75
    diseases, distribution, and control studies 310–313
    export, study of types 309
    extract with oil emulsion, orange thrips, control 519
                pear thrips, control 509
    fertilizer experiments 76, 310, 311–312
        value of inoculated legumes 273

Page.
Tobacco growing, methods, cooperative experiments in Texas.... 313
  Holladay Havana, experiments in growing in Connecticut and Massachusetts.... 311
  insects, control work, 1909.... 503–504
  investigations and experiments, Plant Industry Bureau.... 75–76, 309–313
  manufacturing, study of types.... 309
  nutrition, experiments with potash.... 316
  root-rot control, study and results.... 268
  seed beds, value of steam sterilization.... 311
  Sumatra, acclimated, experiments in breeding.... 312
  varieties, selection and methods.... 310
Tomato ketchup, examination.... 423
    preservation, studies by Bureau of Chemistry.... 100
Tonto National Forest, exclusion of grazing sheep.... 391
Toxic bodies in soil, destruction by oxidation, subdrainage, etc.... 487
  gases, effects on plants.... 439, 468
Transportation, fruit, remarks on improvement.... 79
Trap foods, citrus white fly, studies.... 518
Traps, rat, notes on use.... 117
Treasury Department, cooperation with Agriculture Department, food and drug work.... 36, 38, 40, 41
  Secretary, authority to make regulations for enforcement of Food and Drugs Act.... 36, 38, 40
Trees, camphor, growing, experiments.... 280–281
  drought-resisting, experiments in selection.... 67–68
  forest, study of diseases.... 271–272
  life-history, observations, volunteer, value.... 401
  fruit, nutrition experiments.... 270–271
  olive, drought-resistant studies.... 68
  ornamental, study of diseases.... 271–272
Trespass cases, National Forests, litigation, 1909.... 378–379, 387
Trifoliosis, causes, similarity to "sand-burn".... 231
Trifolium suaveolens. *See* Clover, shaftal.
Truck crops, diseases, investigations.... 72, 267–268
    insects, investigations.... 515–516
    malnutrition, studies at Norfolk, Va.... 268
    studies, Arlington Experimental Farm.... 342
Truckee-Carson Reclamation Project, Nevada, cooperative studies.... 279
TRUE, A. C., report as Director of Experiment Stations Office, 1909.... 683–709
Trypanosome, cattle, investigations.... 240
Tuberculin, cattle, preparation and distribution.... 59
    commercial, testing.... 56–57
    doses, distribution, 1909.... 238
    test, cattle, number reacting, etc.... 203, 218–219
      Great Britain, 1909.... 217
Tuberculins, tests and results.... 60, 242
Tuberculosis, cattle, eradication, methods suggested.... 57
      experiments in diagnosis.... 59
      immunization methods.... 57, 241
      investigations by Animal Industry Bureau.... 56–57, 202–204, 229, 241–243
      prevalence and extent.... 217–219
    definition.... 59
    fowls, studies in Oregon.... 59
    hogs, eradication, methods suggested.... 57
      similarity to pseudo-leukemia.... 223
      sources of contraction.... 59
      studies in Oregon.... 59
    human and bovine, study.... 228
    investigations, Bethesda Experiment Station, 1909.... 241–243
        sources of disease, studies.... 228
    not a bacteriemia, discussion.... 242
    studies in locating infectious centers.... 57
    swine. *See* Tuberculosis, hogs.
Tuberculous cows, commercial, testing.... 57
T'ung oil, trees, Chinese, experiments.... 360–361

Page.

Turkey wheat, growing in dry-farming districts 294
  North Dakota, and results 296–297
Turkeys, wild, statistics, collection 547
Turmeric, adulteration 436
Turpentine adulteration, study by Bureau of Chemistry 102, 443–444
  manufacture from yellow pine waste, experiments 407
  refining, study, Forest Service 407
  wood, refining by steam and distillation, studies 102, 444
Twenty-eight hour law, enforcement 42, 759–773
  violations, cases reported by Animal Industry Bureau 215
    court decisions 760–773

Udder tuberculosis, dangers 242
Upper-air observations, Mount Weather 45–47
Uroloucha acuticauda, Japanese nuns (birds), entry refused 542
Utah, biological survey, progress, 1909, and proposed work 542, 550
  cooperative experiment station studies in soil bacteriology 273
  experiments in selecting dry-land cereals 67
  grazing, cooperation with Forest Service 393

Vaccine, blackleg, preparation and distribution 59, 232
  contaminated, necessity of legislation for control 55
  hog cholera, imported, studies 60
  smallpox, contamination with foot-and-mouth disease 54–55
  virus, contamination with foot-and-mouth disease 198
Vaccines, supervision, need of legislation 205–206
Vanilla extracts, analysis and testing 452, 454, 461
Veal, immature, (bob veal), sale, prosecution 222
Vegetable crops. *See* Truck crops.
  seed, vitality, studies 292
  testing, Arlington farm, results and progress 81, 344
Vegetables, canning, experiments of Chemistry Bureau 425
  garden, varieties, studies 344–345
  insects injurious, investigations 515–516
Vegetation, woody, effects of agriculture, studies 307
Ventilation, stable, experiments and results 63, 252
Vermont, breeding Morgan horses, experiments 60, 61, 244
  white pine disease, study 272
Vessel-reporting service, Weather Bureau, 1909 178
Vetch, hairy, adaptability to jack pine lands 87
    value as cover crop for tobacco 314
  seed, growing and separating, methods 314
    production in Connecticut 314
  use in California 367–368
  winter, use in South Carolina 322
Veterinary education, standards and requirements of civil-service examinations 204–205
Vicia spp., green manure, use in California 367–368
Virginia, Arlington, medicinal plants, studies and experiments 280
  cattle tick, eradication 55–56
  cooperative experiments in general soil bacteriology 273
  demonstration spraying of apples 270
  increase in severity of apple-leaf diseases 269
  Norfolk, truck crop diseases, studies 268
  orchard fertilization, experiments 270–271
  prevalence of chestnut bark disease, study 271
  Tidewater, truck crop insects, investigations 515
  tobacco experiments, expansion of work 310
  Truck Experiment Station, insect work, cooperative studies 515
Virus, rat, experiments and tests, Animal Industry Bureau 237
    tests and results, Biological Survey 60, 533
  vaccine, contamination with foot-and-mouth disease 54–55, 198

Wall papers, poisonous substances, study, Chemistry Bureau 439, 468
Wallowa National Forest, experiments in natural reseeding 288–289
War Department, cooperation of Forest Service 99
Warnings, work of Weather Bureau, review by Secretary 45–47
Washington, D. C., rabies, experiments and results 58

Page.
Washington, soil surveys, cooperation of State.... 478, 481
        water, studies.... 484
      western, forest and soil conditions.... 485
Waste places, danger as harbor for rodents.... 120
    wood, utilizing, study and work, Forest Service.... 406–407
Wastes, trade, investigations by Chemistry Bureau.... 439, 442
Water, irrigation, utilization and prevention of waste.... 143–144
    needs of growing crops.... 483
    purification, studies, note.... 265
    resources, study of snowfall.... 49
    soil, investigations.... 483–485
    supplies, farm, studies.... 272, 273
    supply, packing-houses, sanitary requirements.... 234
        protection by Forest Service.... 90–91
        relation of grazing.... 91
        United States.... 48
Waterfowl, increase, suggestion for providing food plants.... 121
Watermelon, wilt-resistant, studies.... 268
Waters, mineral, examination work of Chemistry Bureau, 1909.... 439–440
    sewage, effects on shellfish, investigations.... 422
Water-shoots, citrus, pruning for control of white fly.... 518
Wax analysis studies, Bureaus of Entomology and Chemistry.... 115, 227
  bees, *See* Beeswax.
Waxy bodies in soils causing low water holding power.... 437
Weather apparatus, new.... 50
    Bulletin, National, issue and supervision, chnges, 1909.... 173, 176, 153
    Bureau employees, examination for promotion.... 180
        estimates and appropriations for 1910.... 560, 564
        exhibit at Alaska-Yukon-Pacific Exposition.... 173
        growth of force 1891–1909, classification of employees, principal officers.... 794, 804–805
        personnel, changes, and statistics, 1909.... 188–193
        publications, classes, description.... 593, 595
            1909, list.... 653–654
        report of Chief, 1909.... 155–193
        retention of instruments by employees, cases, disposal.... 775
        review of work by Secretary.... 45–50
    conditions, relation of solar activity.... 46
    maps and bulletins, description and numbers.... 595
    observers, instruction, 1909.... 181
    Review, Monthly, changes.... 50
    warnings, distribution, and results, press notices, various cities, 1909. 158–165, 182–183
Weed seeds, feeding stuffs, studies by experiment stations.... 134
Weeds, control methods, cooperative studies.... 331
    meadows, eradication methods.... 364
Weevil-resistant cotton, study of types.... 303
Wells, drainage for irrigated lands.... 146
West Virginia soil surveys, cooperation of State.... 478, 481
Wheat, chul, adaptation to California, cooperative experiments.... 295
    composition studies by Bureau of Chemistry.... 100, 417–418
    consumption for food, increase per capita.... 20
    Crimean, analyses.... 417–418
    crop, 1909, value and yield, comparison with previous years.... 11
    drought-resistant, experiments in selection.... 67
    Durum, adaptability to arid regions.... 66–67
        annual production in arid regions.... 66–70
        exports.... 66
        extension of area.... 66–67
      See also Durum Wheat.
    Fretes, adaptation to California, cooperative experiments.... 295
    Great Plains, varieties, experiments.... 294
    growing experiments, results, etc.... 418
    jointworm, control by crop rotation.... 112, 514
    Kharkov, growing, experiments.... 70, 294
    lands, eastern Washington and Oregon, improved methods, study.... 87
            composition and water supply.... 484
    late sowing, for control of insects.... 112, 514

Page.
Wheat, rotation of crops, systems, experiments, note 64
  rust-resistant, crossing experiments with Durum and spring wheat 298
    experiment station studies in Minnesota 298
  "spikelet sterility," caused by rust 297–298
  straw-worm, control by crop rotation 514
  studies in California 70
  Turkey, growing, experiments in Great Plains 294
  varieties, improvement 10
  wild from Palestine, experiments in growing in arid regions 69
  winter, development of hardy varieties, studies 67
    extension, tests in Great Plains 294
Whey butter, manufacture by cheese plant, investigations 255–256
White fly, cause of "curly-top disease" of sugar beets 307–308
    citrus, parasites, fungous, experiments 517
    control studies, Bureau of Entomology 112, 517–518
  pine, disease peridermium strobi, eradication methods, study 272
    rust, study 73
White-pine blight, definition, study 73, 272
White-tops, meadow enemy 364
"Whiteweeds," enemy of meadows 364
WHITNEY, MILTON, report as Chief of Soils Bureau 473–490
WILEY, H. W., report as Chemist, 1909 415–471
Williamson method of corn culture, study 300
Willow, osier, cooperative studies 340
WILSON, JAMES, report as Secretary of Agriculture 9–152
Wilt, tobacco, prevention by clean cultivation 76
Wind, effects on soil, study 489
Wind-breaks, value to farm crops, study, Forest Service 401
Windmills for pumping irrigation water, study 144
Wine-making methods, studies by Bureau of Chemistry 100
Wines, American, studies by Bureau of Chemistry 100
Wintergreen oil adulteration, detection 432
Wireless telegraph, Pacific coast, supervision by Weather Bureau 49, 178
Wireworm, tobacco, damages in Virginia, 1909 503
Wisconsin, cranberry diseases, study 271
    hemp growing, cooperative experiments 77, 286–287
    Madison, establishment of cooperative testing garden 281
    soil surveys, cooperation of State 478, 481
    University, forest products laboratory, cooperative 412
Women, Farmers' Institutes, organization and work 138
Wood preservation work, 1909, amount and value 404
  waste, utilizing, study and work, Forest Service 406–407
Woodpeckers, beneficial and injurious 540
Woods, testing, cooperative work, Forest Service 405–406
Wood-using industries, requirements, studies 403
Worms, lamb, control experiments 238
Wyoming, breeding sheep, experiments 60–61
    infected sheep, establishment of quarantine 58–59
    lip-and-leg ulceration, outbreak 204, 225

Yearbook, Department of Agriculture, sources of statistical data 664
    distribution to correspondents 668
Yeast cultures, distribution, 1909 421
  fermenting power, studies 420
Yellow pine waste, utilizing 407
    See also Pine, yellow.

ZAPPONE, A., report as Chief of Division of Accounts and Disbursements, 1909 .. 553–590
Zebra-ass, hybrids, breeding experiments at Bethesda, Md., experiment station 60–61, 246
Zebra-horse breeding, experiments, 1909 246
Zinc chlorid, wood preservation, amount used, 1909 404
Zones, crop, study 121
  life, study 121

13 11430